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Budget Cuts Tool Costs

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Budget Department, Graham-Paige Motors Corporation

Three years of successful operation at the Graham-Paige Motors Corporation has proven the worth of this method of expense control

BEFORE entering into a description of the system, a few of the results accomplished by it will be given. The reader is asked to bear in mind that it was and still is, to some extent, in the experimental stage, but with the experience gained and from records of cost compiled in the past three years, we know where we are going and why and that much can be done to lower the perishable tool cost still further.

The average of all models in the aggregate is given in the tabulation below:

Year	Budget per car	Actual cost per car	Total saving	Salvage per car	Total salvage	Cars produced
1928	None	$2.3949	No record	No record	No record	72002
1929	$1.8943	1.6136	$53,700.50	$0.1115	$8816.62	79059
1930	1.4460	1.0351	19,039.34	0.2270	7470.50	32914
1931	0.9139					

In order to present the cost of the individual car part, a few parts common to most automobiles have been selected and the results obtained are tabulated below. In addition some idea of the way these results were achieved is given.

Cylinder block—six-cylinder, 3¼-in. bore, seven main bearings. This includes the cost of machining and assembling seven main bearing caps and assembling and reaming the valve guide bushings and front camshaft bushing.

Year	Budget per car	Actual Cost per car	Salvage per car
1928	None	$0.6891	No record
1929	$0.5823	0.4016	$0.0212
1930	0.3828	0.1862	0.0602
1931	0.1676		

Two machines were used to finish line ream the seven main bearings and four camshaft bearings. One machine was converted into a semi-finisher, and the other used as a finisher, both being speeded up slightly. When finish reamers wear undersize, they are used as semi-finishers, and as each reamer removes less stock than before, there is less tool grinding and a consequent longer life for each reamer. Reaming cost in 1929 equaled $0.0301 per car and in 1930, $0.0166 per car.

Twelve valve spring seats, 1¼ in. in diameter were back counterbored in another cylinder block operation. The master mechanic converted this machine into an automatic which permitted turning the work over and using a regular counterbore. The stronger tools and visibility to the operator eliminated excessive pilot and cutter breakage. In 1929 the tool cost equaled $0.0256 per car and in 1930 $0.0056 per car.

Another operation was the machining of two lugs which formed the generator seat. Each was about one-third of a circle making an intermittent cut. Fly cutters used for this work would frequently snap off. This operation had a tool expense of 15 cents per car. The master mechanic took the matter up with the engineering department, and as a result, the generator seat is no longer machined—does not have to be because the generator is driven by a flexible coupling.

After many tests, honing the six 3¼-

Form 904

NON-PRODUCTIVE MATERIAL REQUISITION

TOOL AND SUPPLY STORES

DATE 11-10-31

ACCOUNT No. 262 ORDER No. REQUIRED FOR DEPT. NO. 39-8

QUAN.	SYMBOL	SIZE	KIND	NAME	UNIT	VALUE
1		No.2	Magic	Drill Chuck		
		No.2	M.T.	Shank		
				SALVAGE		

NOTE—ALWAYS SHOW REASON DRAWN - ON TOOLS SHOW PART NO. AND MACHINE NO. WHERE USED - CHECK WHETHER BROKEN - WORN OUT - OR DAMAGED.

BROKEN √ WORN OUT √ DAMAGED √

REASON DRAWN MACH. NO.

PART NO. 7555

REQUESTED BY DEPT. NO. 39-8 REC'D BY 39901

SIGNED BY R. Missner DEL'D BY

Tools are withdrawn on this form at the discretion of the foreman, but the amount is checked against the departmental budget

in. diameter bores was reduced in cost by selection of the proper grain and grade of hone to use with the block material. Cost per car was $0.0448 in 1928, $0.0160 in 1929 and $0.0168 in 1930.

Many other instances of tool cost reduction might be cited in detail if space permitted. Overall savings only will be given for a few other parts.

Motor piston—3¼ in. O.D., 3⅝ in. long, aluminum alloy, 6 pistons per car.

Year	Budget per car	Actual Cost per car	Salvage per car
1928	None	$0.1619	No record
1929	$0.1546	0.1542	0.0008
1930	0.1288	0.0828	0.0018
1931	0.0744		

Connecting rod—Drop forging, 9¼-in. centers, 2¼-in. bearing size, ⅛-in. wrist pin hole, 6 rods per car.

Year	Budget per car	Actual Cost per car	Salvage per car
1928	None	$0.1842	No record
1929	$0.1472	0.1574	$0.0206
1930	0.1340	0.1100	$0.0117
1931	0.0990		

Flywheel housing—cast iron, 5½-in. transmission pilot hole, 2 motor support arms, motor and transmission faces finish ground.

Year	Budget per car	Actual Cost per car	Salvage per car
1928	None	$0.1081	No record
1929	$0.1061	0.0975	$0.0011
1930	0.0871	0.0830	0.0070
1931	0.0504		

Flywheel—cast iron, 13¾ in. O.D., finished weight 48½ lb., finished all over.

Year	Budget per car	Actual Cost per car	Salvage per car
1928	None	$0.1290	No record
1929	$0.0810	0.0453	$0.0005
1930	0.0368	0.0323	0.0218
1931	0.0313		

Cylinder head—for 6-cylinder car, Ricardo type, combustion chamber not machined.

Year	Budget per car	Actual Cost per car	Salvage per car
1928	None	$0.1185	No record
1929	$0.1009	0.1080	$0.0114
1930	0.0904	0.0463	0.0128
1931	0.0359		

In going over the above tabulations, it is apparent that the expense for the year 1928 was abnormally high. This is true for two reasons: The first and unremediable reason was that in that year a complete line of new models was introduced with the attendant heavy initial expense for permanent set-ups (by permanent set-ups is meant the tools put in use at the beginning of production in order to insure against undue hold-ups) which must be absorbed along with regular tool replacements in the first year of production; The second and remediable reason was inadequate records of past performance which records should show the improvements made through the practical experience of cost cutting in the past. Not being fortified with complete records of past performance, there was no set goal at which to aim upon the introduction of the new models.

Now that a few of the results obtained by this system have been given, we will enter into a description of the system itself. It is based upon five forms as follows:

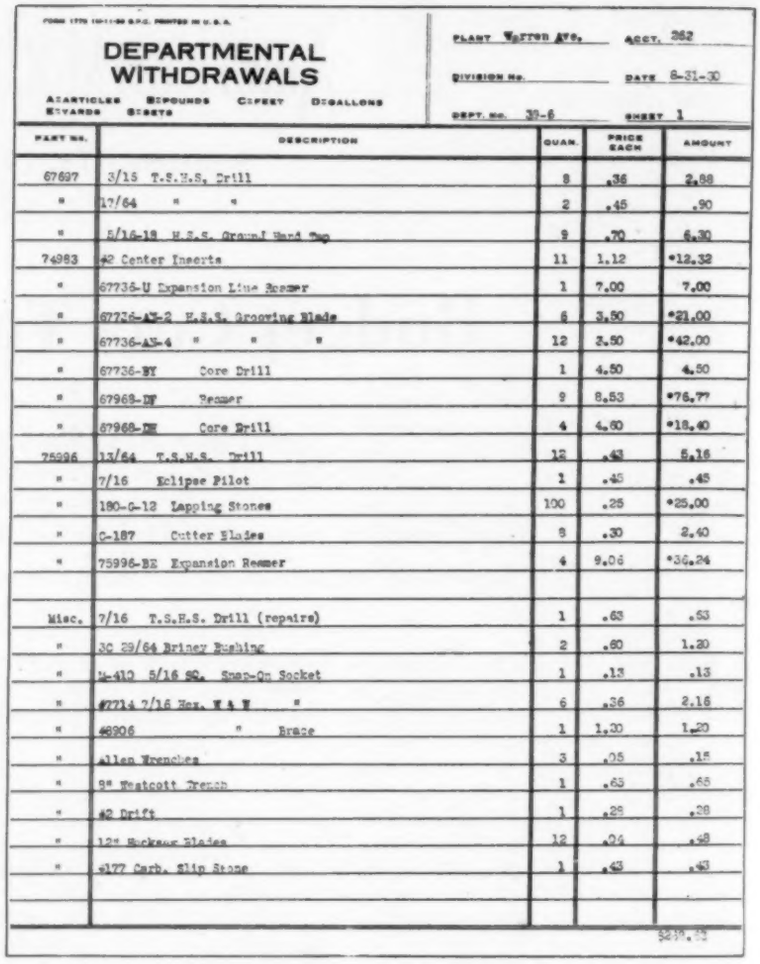
Non-productive material requisition;
Departmental withdrawal sheets;
Budgeted allowance sheet;
Budgeted expense report;
Perishable tool expense chart.

Reports are issued semi-monthly; the first period is from the 1st to the 15th inclusive, and the second period from the 16th to the 31st inclusive. The allowed expense based on the production of cars in each period is set against the actual expense incurred in each period.

The non-productuve material requisition is filled out by the machine shop foremen and is presented to the general tool stores or one of its branch tool cribs or the permanent set-up tool crib where the desired tools are obtained. The requisitions are retained by the general tool stores until the termination of a report period when they are sent to the budget department.

The budget department sorts the requisitions, first according to the machine shop department numbers and then numerically according to the car part numbers machined by each department, and posts them on the departmental withdrawal sheets which are then priced, extended and totaled. The total expense incurred by each machine shop department for a half month, as found on the departmental withdrawal sheets, is then posted on the budgeted expense report in the "Actual" column, under the heading, "Expense for Period."

The budgeted allowance sheet gives



DEPARTMENTAL WITHDRAWALS

(ARTICLES · POUNDS · CUFEET · GALLONS · YARDS · SHEETS)

PLANT Walton Ave. ACCT. 262
DIVISION No. DATE 8-31-30
DEPT. No. 38-6 SHEET 1

PART NO.	DESCRIPTION	QUAN.	PRICE EACH	AMOUNT
67697	3/16 T.S.H.S. Drill	8	.36	2.88
"	17/64 " "	2	.45	.90
"	5/16-18 H.S.S. Ground Hand Tap	2	.70	1.40
74983	#2 Center Inserts	11	1.12	*12.32
"	67736-U Expansion Line Reamer	1	7.00	7.00
"	67736-A3-2 H.S.S. Grooving Blade	6	3.50	*21.00
"	67736-A3-4 " " "	12	3.50	*42.00
"	67736-BY Core Drill	1	4.50	4.50
"	67968-DF Reamer	2	8.53	*76.77
"	67968-DE Core Drill	4	4.60	*18.40
75996	13/64 T.S.H.S. Drill	12	.43	5.16
"	7/16 Eclipse Pilot	1	.45	.45
"	190-G-12 Lapping Stones	100	.25	*25.00
"	C-187 Cutter Blades	8	.30	2.40
"	75996-BE Expansion Reamer	4	9.06	*36.24
Misc.	7/16 T.S.H.S. Drill (repairs)	1	.63	.63
"	3C 29/64 Brincy Bushing	2	.60	1.20
"	M-412 5/16 SQ. Snap-On Socket	1	.13	.13
"	#7714 7/16 Hex. " "	6	.36	2.16
"	46906 " Brace	1	1.30	1.30
"	Allen Wrenches	3	.05	.15
"	9" Westcott Trench	1	.65	.65
"	#2 Drift	1	.28	.28
"	12" Hacksaw Blades	12	.04	.48
"	#177 Carb. Slip Stone	1	.43	.43

From the requisitions, the tools withdrawn are posted on departmental withdrawal sheets giving the part number, quantity and price

BUDGETED ALLOWANCE-MACHINE SHOP-1931

Dept. No.	Models and Allowance Per Car 53	54	49	42-A	44	36-A	37-A
39-1				.2235			
39-3	.1676	.1676	.2309	.0074	.1676		
39-4	.1317	.1341	.1407	.1400	.1325	.0231	.0231
39-5	.2227	.2227	.2638	.2643	.2227	.0744	.0744
39-6	.1123	.1123	.1372	.1372	.1123	.0379	.0379
39-7	.0416	.0416	.0447	.0522	.0854	.0293	.0293
39-8	.1863	.1863	.1863	.1893	.1745	.1300	.1283
39-10	.0285	.0308	.0342	.0465	.0199	.0610	.2638
Totals	$.8897	$.8944	$1.0538	$1.0804	$.9149	$.3559	$.3568

Average Budgeted Allowance Per Car - All Models - - $.9139

New budgeted allowance sheets are issued during each year as new car parts are added or as major engineering changes are made

the allowance per car for each model of every department in the machine shop. These allowances, multiplied respectively by the production of each model and totaled, give the allowed expense of each department for the period. This allowed expense is posted on the budgeted expense report in the "Allowed" column under the heading "Expense for Period." The difference between actual expense and the allowed expense is posted in the "Over" or "Under" column under the same heading and shows whether the departments are over or under the budgeted allowance for the period.

The actual expense and allowed expense for the period are added respectively to the total actual expense and allowed expense accumulated in the previous periods and posted in the respective "Actual" and "Allowed" columns under the heading, "Accumulated to date." This shows the standing of each department or the whole division since the beginning of the year.

The perishable tool expense chart gives in picture form essentially what is given in figures on the budgeted expense report. Horizontally through the center of each small chart is the base line. The graph is plotted above or below this line according to whether a department is over or under its budgeted allowance; the figures at the left of each small chart show in percentage the degree of efficiency of each department.

On the inclined lines at the top and bottom of each small chart is shown the amount in dollars at the termination of each half-month that a department is over or under its budgeted allowance. A small chart in the lower right-hand corner gives, in the same way, the standing of all the departments combined, that is, the whole machine shop division.

Three of the large charts are made up, one for the budget department for quick reference, and it is also used by the machine shop foremen to see how each stands relative to the others; one for the superintendent of the machine shop; and one for the factory manager. Small charts are also cut out, and one is given to each foreman of the machine shop, and they are kept up to date.

The departmental withdrawal sheets are made up in triplicate, one pencil copy and two carbon copies. The pencil copy is retained by the budget department; the first carbon copy goes to the superintendent of the machine shop; and the second carbon copy goes to the machine shop foremen.

The budgeted expense report and budgeted allowance sheet are both issued in quadruplicate. The original copy goes to the factory manager; the second copy is retained by the budget department; the third copy goes to the superintendent of tools; the fourth copy goes to the superintendent of machine shop.

The chief means of locating tool trouble or excessive tool expense is the departmental withdrawal sheets. To illustrate how the sheets are used for this purpose let us consider the withdrawal sheet for Department 39-6 in glancing down the "Amount" column on this sheet, there are seven items that strike the eye. They are $12.32, $21.00, $42.00, $76.77, $18.40, $25.00 and $36.24. If there is any serious tool trouble in this department, it should be centered in one or more of these seven items as far as this particular withdrawal sheet is concerned.

The perishable tool expense chart for Department 39-6 for the period ending August 31 shows this department to be $1,661.06 under the budget at this time. The department as a whole cannot be in a serious condition; still there may be excessive tool expense in one of the seven items. Previous to this period there have been withdrawal sheets issued for fifteen other half-month periods. Because we have checked the tool usage on the previous withdrawal sheets, we know that all seven items were all right and that the tool usage on six other of the items is still all right, but on one of the items something is not as it should be. This particular item is the 67968-DF reamer used for reaming the wrist pin holes in the 74983 piston.

Normally, only three of these reamers are required for permanent set-up purposes, so when nine of them were drawn out in a half-month it looked like tool trouble, possibly excessive tool breakage. So we took the matter up with the foreman of the department and asked him why he drew out so many reamers at one time. He said, "I'm quite a lot under my budget, and I found out this piston is going to be used on two of next year's models, so I thought I would stock up a little for next year." The foreman's idea is O.K. It doesn't affect the budget any as far as normal tool usage is concerned, that is, he wouldn't receive a larger budget per piston or per car in the next year because of the excessive withdrawals, but it does help him in holding down next year's expense. If he does build up excessive permanent set-ups and some of the car parts do go obsolete, it is his own funeral, since he is responsible for the tool expense in his departments. Should a foreman thus persist in building his permanent set-ups too high, his budget will be lowered accordingly.

Checking Tool Expense

Suppose we are checking a tool for normal tool usage; we take out all the expense on the tool as found on the withdrawal sheets, then phone the production records department and obtain the actual number of car parts made, not including machine scrap; from these we obtain the cost per car and compare with previous records. In the absence of previous records, if the tool expense is high, we take the matter up with the master mechanic, who takes steps to rectify the condition if possible.

The budget department should check the tool expense of individual tools and operations whenever possible, for in so doing it supplies itself with a fund of knowledge and excellent records for future use, especially in the budgeting of new car parts. It also supplies the master mechanic and tool trouble department with the necessary impetus to bring about a reduction of car cost.

We anticipate two objections raised against this budgeting system. The first objection is that it is too cumbersome, involves too much detail work. This is true in the first year, while the original

BUDGETED EXPENSE REPORT

Plant: Warren Ave.
Acct. No. 262
Dept. No. 39
Period Ending 8-31-31

DEPT. UNIT	EXPENSE FOR PERIOD				ACCUMULATED TO DATE	
	ACTUAL	ALLOWED	UNDER	OVER	ACTUAL	ALLOWED
1		32.45	32.45		1009.12	1355.14
3	61.70	282.22	220.52		4932.52	9848.49
4	69.27	192.67	123.40		5424.61	6912.46
5	55.99	330.87	274.88		8059.82	11564.39
6	268.63	175.35		93.28	4245.45	5906.51
7		19.70	19.70		564.32	635.51
8	91.25	219.51	128.26		7237.14	7866.47
10	52.57	18.33		34.24	748.79	647.45
TOTALS	$599.41	$1271.10	$799.21	$127.52	$32,221.77	$44,736.42

BASED ON A PRODUCTION OF:		
MODEL	CARS — PERIOD	CARS TO DATE
46	566	21105
45	159	3814
42	88	3670
44	7	590
36	4	186
37	17	258

ACCUMULATIVE SUMMARY

Actual Expense	$32,221.77
Allowed Expense	$44,736.42
Under	$12,514.65
Over	

This forms a cost statement and is a source of information for those who do not wish the details of tool usage as given on the departmental withdrawal sheets

budget is being compiled, but is not true in the following years, for in these years the reduction in cost per car accomplished will be in about direct proportion to the amount of detail work done in running down the tool trouble on individual tools, operations, or car parts, thus automatically producing tool cost records that make budgeting simple and easy. This means that if the budget department is active in the current year, they are familiar with the tool cost on each car part and on many of the individual tools, especially in those cases in which they have been instrumental in bringing down the per car cost. Because of this, it can, with speed and accuracy, make up a budget for the next year. The detail work in a current year from which good cost records are obtained is necessary if the budget department is to be successful in selling the next year's budget to the shop foremen and superintendent of machine shop because they both want to know where they are going and why.

The second objection, raised against this budgeting system, is that the tool usage as shown on the departmental withdrawal sheets is a half-month old before the sheets are made up. Because of this, any number of tools might be broken or otherwise wasted during the half-month period. Our experience has been that since the departmental foreman or his head job-setter must sign each tool requisition, one or the other of them should be aware of any sporadic tool trouble developing in his department. If not, the budget department will detect such trouble before it is more than a half-month old.

It is not the chief aim of this budgeting system to detect sporadic tool trouble, but rather to expose the lack of economy and chronic sources of tool expense, that is, particular tools or methods of machining that were installed four or five years ago and because of their age the inefficiency and heavy tool expense attached to them has been forgotten. By stirring up a little trouble over these one-time-licked tools or methods, tool expense is improved.

Sometimes the reverse is true; the new tool or method may be proven to have a greater tool expense than an older tool or method. At all times, where the tool expense per car is high in proportion to the work being done, we investigate, taking it up first with the departmental foreman who usually has reasons for the condition. This information, together with the tool expense, is passed along to the master mechanic, who generally finds a solution for the case as in the examples given at the beginning of this article.

Setting Up the Budget

Each period after the withdrawal sheets are made up, the amount of money spent for tools on each car part number should be set against it on a separate sheet of paper so that when November 30 (assuming the year to close on December 31) arrives, the total amount of money spent on each car part has been recorded. The production of each car part is then obtained from the production records department, and with this information, the actual cost per part is calculated. Together with notes on improvements made during the year, the budget per car for each model is set up for the next year. New parts are easy to handle as they are generally similar to the old part, or the operations are similar to operations on other parts. At the close of the year, the total expense for each car part and the total year's production of the model on which the car part was used are obtained, the actual cost per car for each car part is calculated, and the actual cost per car, per model for the past year is thus obtained.

Our budget department is advantageously located in the tool salvage department where the machine shop foremen are in and out all day looking for salvage tools, which are free of charge, to reduce their tool expense and enable them to get under the budget. The budget department keeps its perishable tool expense chart thumb-tacked on the wall in plain view so as to encourage competition between the foremen. When they come after salvage, they almost invariably step over for a look at the chart. If one foreman finds himself making a poor showing relative to the others, he generally asks what tools he is running high on. We tell him, and he usually says, "I'll concentrate on them, and you let me know how I'm coming, will you?" If the foreman in the lead finds another creeping up on him he usually asks the same question; all are interested in trying to reach the lowest percentage.

The objection is sometimes raised that the difference between two consecutive inventories can throw this budgeting system off and not give a reliable tool cost

per car. The difference between machined car parts left unassembled at the end of a year and the machined car parts carried over from the previous year is in general so slight as to be almost negligible when the tool expense is spread over a whole year. In addition to this, tools in use at the end of a year and paid for in that year are also carried over for production in the following year.

When new models are introduced or engineering changes made, involving new set-ups, one complete new set-up of tools for each new car part or changed car part is given to the machine shop free of charge, and the tool expense of the new set-up is carried on the books of the accounting department and depreciated in the same rate as jigs and fixtures. When a model is obsoleted or engineering changes made, all the tools in use in the machine shop and all special tools in the tool stores on the obsoleted or changed car part immediately become the property of the tool salvage department for them to place in use where they see fit. The tool expense of the obsoleted tools is written off the books of the accounting department.

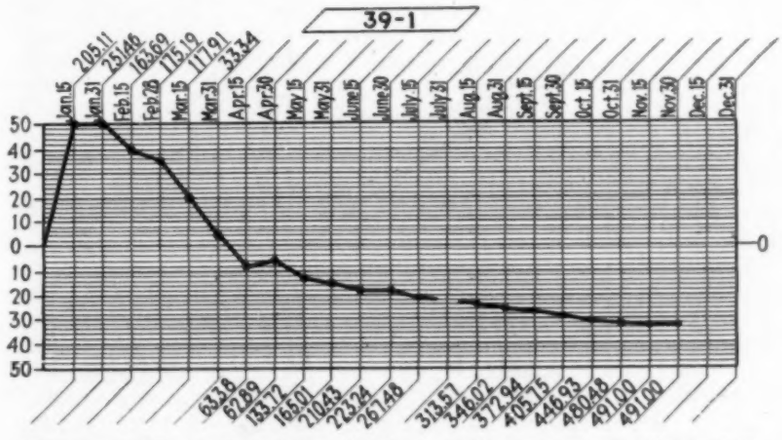
Needless to say that this budgeting system with a change of forms to suit the needs can easily be adapted to control machine spoilage or scrap, operating supplies, machinery repair, jig and fixture repairs and renewals, and car material accounts. It can also be adapted to the control of non-productive labor expense in departments such as inspection, toolroom, machinery repair, tool design, and machine layout. Each of these departments has a fixed personnel, the expense of which ceases only when the whole plant is closed down. The budget for the personnel is fixed at a definite yearly amount, and the budgeted allowance is made semi-monthly; all other non-productive labor in each of these departments must vary with the production schedule and must be budgeted accordingly. This means that the fixed budgeted allowance for the personnel is added to the budgeted allowance of the other non-productive labor, which will vary according to production, and would be posted semi-monthly in the allowed column of the budgeted expense report. The payroll will determine the amount to be posted in the actual column of the same report. Additional labor expense required, when introducing new models, is estimated from past experience and cared for on a special appropriation and does not interfere with the budget.

Any tools, not proving successful for production because of improper design or tooling, are charged against the departments responsible; in no case are such tools charged to the machine shop. The placing of the responsibility for such tools in case of dispute is left to the factory manager.

The successful results obtained by this budgeting system in the Graham-Paige Motors Corporation have been accomplished without any incentive; that is, no bonus has ever been paid for equalling or beating the budget.

The actual cost per car is always the end sought; this is necessary to obtain the true budgeted allowances per car for each model. By this is meant that if a car part formerly purchased is introduced in the middle of a year to be machined, the actual cost per car for that year will be different than the cost per part; also if a certain car part is used on only a percentage of the cars of a model, like the luggage rack brackets which may be used on that car only that is equipped with side mount spare wheels, the cost per car and cost per part are different.

Budget each department close enough to make the foreman exert himself to beat his budget, but never budget so closely as to make it difficult for a foreman to even equal his budget. He will become discouraged and not try when he thinks the task is hopeless, but if he makes good progress, he will stage a race with some other department to see which can save the most money or have the lower percentage. Better results are obtained if the foremen do not feel the pressure of the budget. We all like to win, but we do not want to feel as though somebody is forcing us to do it.



Departmental standing from the first of the year up to the period indicated is given by percentages and the amounts the department is over or under the budget on the perishable tool expense chart

A Right Angle Drive
Discussion

FRANCIS W. SHAW
Tool and Gear Consultant, Heywood, Lancashire, England

In an article under the title given above (*AM*—Vol. 76, page 789), John T. Giddings gives the calculations for helical gears to be used in a right-angle drive. I think he has taken a long cut that is not the most accurate way.

It is well to remember that in helical gears the ratio represents the tangents of the helical angles when the diameters are equal. In the given example, the ratio is either two or one-half, depending upon which gear is the driver. The two tangents are therefore 2.0000 and 0.50000, corresponding to angles of 63 deg. 26 min. and 26 deg. 34 min., respectively. Instead of finding both angles, having found one, preferably it should be subtracted from 90 deg. to find the other.

Again, there is no need to bring in the circumference; the diametral pitches can just as well be used, saving the trouble. Since the pitch diameter of both gears is 6¼ in., the real diametral pitches are: $\frac{25}{6\frac{1}{4}} = 4$, and $\frac{50}{6\frac{1}{4}} = 8$. That is, one pitch is twice that of the other, and the gear ratio, therefore, also represents the ratio of the pitches.

The point upon which I would insist is this: That, having fixed the pitch diameters and the numbers of teeth, the helix angles and the pitches are unalterable. If, in order to utilize cutters of standard pitch the helical angle must be modified, it can be done only by altering the ratio of the pitch diameters.

In the given example, the normal pitch is so close to 9 diamentral that no modification is necessary. The normal pitch, found by dividing the real pitch of either gear by the cosine of its helix angle, is 8.95 diametral. A correct 9-pitch cutter sunk into a correct blank the theoretical depth will cut a space 0.001 in. too narrow. It should be sunk in about 0.002 in. deeper, an amount that will have no appreciable influence on the tooth form. The figure 0.001 in. is the difference between a cutter of 9 pitch and one of 8.95 pitch.

Spherical Surfaces of Slight Curvature

I. C. GARDNER
Physicist, Bureau of Standards

IN CONNECTION with the production of mechanical parts, it is sometimes required that a relatively small surface, say six to twelve inches in diameter, be faced not plane but with a spherical surface of large radius of curvature. Such a demand is regularly encountered in the manufacture of lenses.

To grind a spherical face on a lens, an iron or brass tool is used, usually from 4 to 12 in. in diameter, and with one face curved to fit the surface desired. If the radius of curvature of the desired surface is not too large, a spherical surface may be turned on an ordinary lathe by mounting the tool on the end of a radius rod so that it will move in the proper arc as it is advanced across the face which is to be finished. However, with the usual lathe, having an 8 or 12 in. swing, it is decidedly inconvenient to use a radius rod more than 6 or 8 ft. in length, although surfaces with larger radii of curvature are often required.

There is also a method by which spherical surfaces may be milled or ground by a cup-shaped tool, but the employment of the machine required for this method is not practicable in many cases because of its great cost. Surfaces slightly curved may also be produced on a lathe by arranging the tool to be guided by a templet of the desired curvature, but this method is objectionable because it requires the construction of a templet for each curvature.

To escape these difficulties, an attachment has been designed and built, which is mounted on an ordinary lathe in place of the compound slide rest, and which embodies a simple linkage system by which approximately spherical surfaces may be generated. Surfaces, either concave or convex and having any radius of curvature greater than 20 in. can be produced. Although the surfaces produced are not rigorously spherical, the approximation is quite satisfactory over the greater portion of the range of the instrument and is poorest for the more strongly curved surfaces. These latter surfaces are precisely those that can be most conveniently produced by a tool on the end of a radius rod, so that the two methods, taken together, supplement each other and enable the complete range of curvatures to be made readily.

The fundamental parts of the instrument are show schematically in Fig. 1. The base plate *KLMNO* of the attachment is mounted on the carriage of the lathe after the compound rest has been removed. The main slide *CD* is pivoted to the base plate at *A*. The secondary slide *GH* is pivoted to the same plate at *B*. The tool *J* is mounted on the carriage which is indicated by cross-hatching and which travels across the bed of the lathe in the slide *CD*. This carriage is extended to the right to form the two projecting lugs. One lug carries the bearing at *P*, the other circular arc at *I*. The piece *EF*, pivoted at *P*, can be clamped by means of the nut at *I*, at an angle with the slide *CD*. This piece *EF* slides in the secondary slide *GH*.

In the first sketch the tool *J* is in the prolongation of the axis of the lathe, and the bearing *P*, by which *EF* is attached to the carriage which bears the tool, is concentric with the bearing *B* by which the slide *GH* is attached to the base plate. In the second sketch, which shows the tool displaced from its central position, the two bearings are not superimposed.

For any given radius of curvature, the piece *EF* is clamped at a definite angle with the slide *CD* and remains at this angle during the turning of the surface. If *EF* is parallel to *CD*, the two slides remain parallel during the movement of the tool, and a plane surface is produced. If *EF* makes an angle with the slide *CD*, as the car-

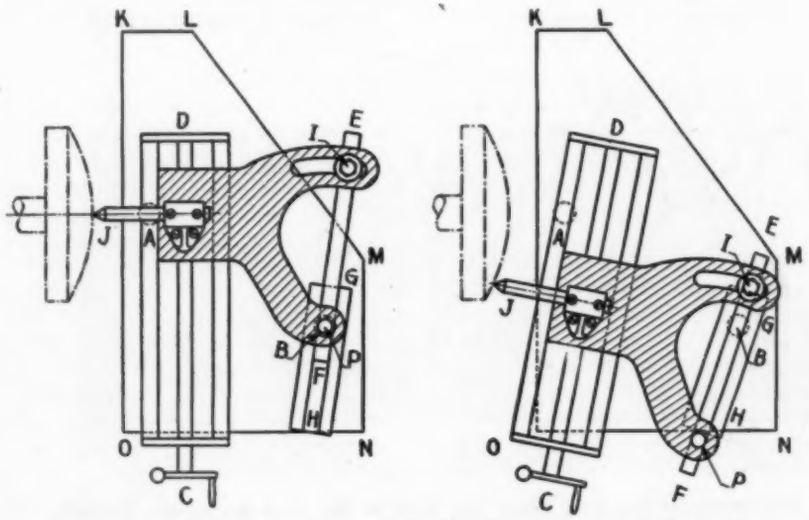


Fig. 1—A combination of cross feed and rotation cause the tool to follow a path closely approximating a true circular arc

Publication approved by the director of the Bureau of Standards, U. S. Department of Commerce.

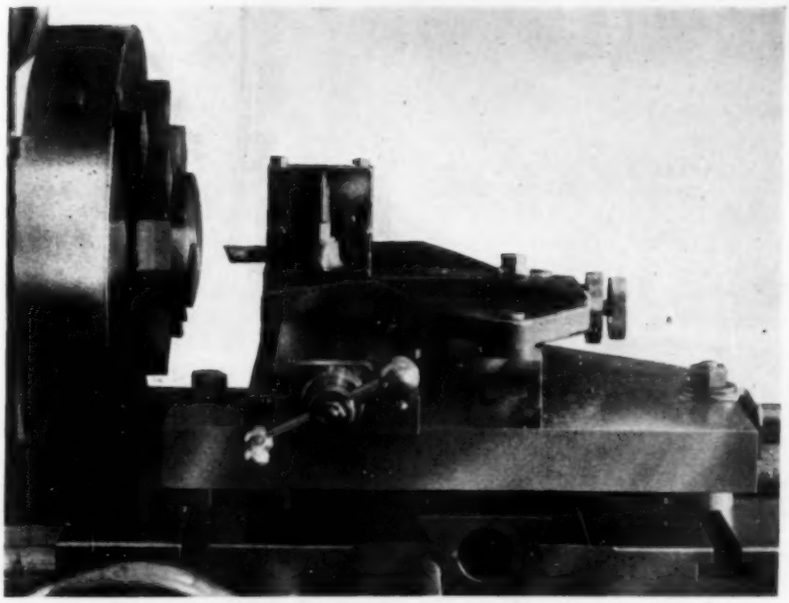


Fig. 2—Viewed from the front, the positions of the two slides are shown as set for convex work

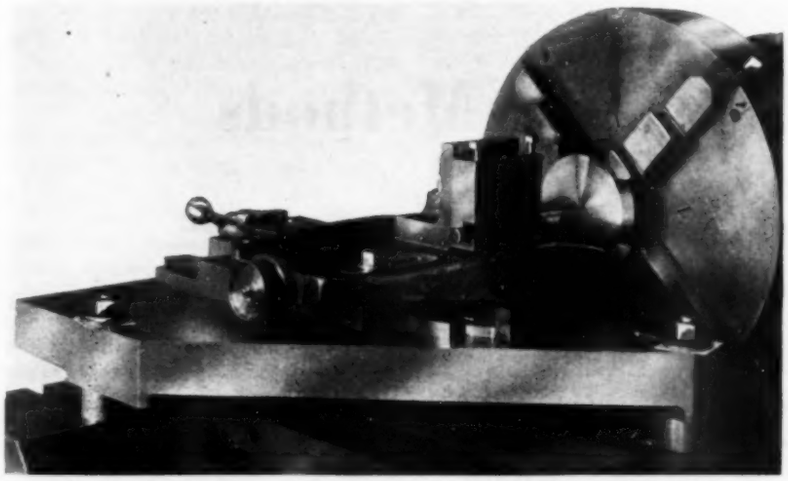


Fig. 3—A micrometer adjustment permits accurate setting of the auxiliary slide

riage moves across the bed of the lathe, the slide *CD* is caused to rotate about the point *A*, and the tool at *J* describes an approximately circular arc. With *EF* set as shown, a convex surface is produced. If the piece *EF* slopes in the opposite direction with respect to *CD*, a concave surface is generated.

In an early number of the Bureau of Standards *Journal of Research*, there will appear a more detailed description of the linkage with a derivation of the equation of the curve generated and equations by which the character of the approximation to a spherical surface may be determined.

Figs. 2 and 3 are photographs of the completed instrument mounted on a lathe. This instrument was built by the Mann Instrument Company of Cambridge, Mass., and this company is responsible for many of the constructional details which have contributed materially to the successful working of the instrument. In these two photographs, the two slides and the other fundamental parts indicated in Fig. 1 can be readily identified. The part *EF*, which fits in the secondary slide, is carried by a gear segment, and a micrometer head is provided by which precise settings can be readily made. This attachment is designed to be used on a lathe with a 12-in. swing and will turn surfaces, either convex or concave, with any radius of curvature greater than 20 in.

The approximation to a spherical surface becomes poorer as the diameter of the surface increases or as the radius of curvature decreases. The poorest approximation within the range of the instrument arises when the surface is 12 in. in diameter and convex with a radius of curvature of 20 in. In this case, the maximum departure of the actual surface from a spherical surface is 0.012 in. For a concave surface, under similar conditions, the departure is only 0.006 in.

Although these approximations may be unsatisfactory for some purposes, it should be borne in mind that these values lie well within the region for which a radius bar is satisfactory and that the approximation afforded by the instrument improves rapidly as the diameter of the surface is decreased or the radius of curvature increased. For example, if the work is 8 in. in diameter and the radius of curvature is 40 in. the departure from a spherical surface, either convex or concave, is less than 0.001 in. If accurately spherical surfaces are required, they may be produced by turning a pair of convex and concave surfaces and afterwards lapping them together with an abrasive. However, in many cases, even for such precise work as lens grinding, the surface will be found satisfactory as turned without any additional working.

Cutters for Milling Deep Slots

IRA S. WILLIAMS

In milling deep slots in steel with a regular side-milling cutter, it was found that heavy feeds were prohibitive, due to the chips dragging between the flanks of the cutter teeth and the sides of the slots, marring the finish.

With a slower feed the finish on the sides of the slots was improved, due to the smaller chip taken by each tooth. However, with the slower feed the finish on the bottoms of the slots was marred by chatter marks caused by one or more of the three following conditions: First, the arbor ran out slightly; second, the cutter had one or more teeth slightly higher than the others; and third, the teeth of the cutter ran in synchronism with the teeth of the driving gear on the machine. After these conditions had been corrected in so far as was possible, the feed had to be slowed down, which made the cost prohibitive.

It was felt that if a regular coarse-tooth high-speed steel side-milling cutter, without rake or clearance of any kind on the sides of the teeth were used, and a heavy enough feed were maintained to keep a strain on the arbor at all times, better results would be obtained. Such a cutter was ordered and the results from its use far exceeded all expectations. A mirror-like finish was obtained on the sides of the slots and there were no chatter marks on the bottoms. Incidentally, the cutting time was shortened by approximately 50 per cent.

Large and small parts of locomotives taken down for complete overhaul are cleaned in this back shop tank preparatory to reassembling

Railroad Cleaning Methods

LeBARON B. JOHNSON
Manager, Service Department, Oakite Products, Inc.

With railroad costs under close scrutiny, all phases of shop practice are being given careful attention. Up-to-date cleaning methods form one way of effecting economy with improvement in results

•

CLEANING is used, in this article, in its broadest sense, that is, the removal of substances, usually called dirt, but which may be grease or old paint. This cleaning may be divided into main divisions:

1. The removal of dirt, grease, carbon, or other substances so the resultant surface may be left clean for appearance sake.

2. (a) As in the case of a piece of machinery, cleaning so the moving parts may be relubricated and function with less wear than when foreign matter is present. (b) The cleaning or removal of old paint preparatory to a repaint job.

The present method employed by many roads is to boil all the removable parts of the running gear including connecting rods, binders, nuts and bolts in large tanks of strongly alkaline cleaning materials. While this type of material, such as lye or caustic soda, will remove most of the grease and dirt after a long boil, better and quicker results are being obtained from cleaning materials which form an emulsion of the grease or dirt instead of forming a soap compound as with strong caustics. Where an emulsion is formed in the tank, the life of the solution is greatly lengthened, because when the tank cools down, the small globules of grease float to the surface and may be removed. By a small addition of cleaning material, the solution is brought back to its original strength. Another advantage of emulsifying cleaning materials is that they are entirely safe to use, which is not so with strong caustic solutions.

After all the removable parts have been removed from the locomotive, the frame has usually been cleaned preparatory to fracture test by hand scraping. It usually takes one man a day to perform this work. The disadvantage of this system is that it is impossible to clean the frame perfectly by scraping or washing down with distillates.

The most up-to-date method of cleaning frames is by the steam gun employing a jet of steam at a pressure of from 25 to 50 lb. into which a weak solution of cleaning material is injected under pressure. The metal or painted surface of the frame is left clean by this method. The result is that any crack or other defect may easily be seen after a coat of whiting has been applied. The length of time that one man will take to clean a complete frame by this method, using low pressure steam of from 25 to 40 lb., is four hours.

The steam coming out into the locomotive shop is not objectionable. It amounts to so little that men may work in the next pit on either side. It is possible to do a good job in cleaning the frame in about half the above time by using 60- to 70-lb. steam in the gun. This pressure will cause clouds of steam in the shop, which is likely to inconvenience other operators. Where high-pressure steam is used, the work is usually done by the night shift, when it is necessary to have the frame thoroughly illuminated by flood lights.

The labor saving is at least 50 per cent. The cost of cleaning solution consumed is about 25 cents per hour of steady use.

Some large railroad systems employ the gun method of cleaning parts that were previously boiled off in the large

back shop tanks. Where there is sufficient cleaning work to keep the large tank employed all day, it is cheaper to use the tank method for these parts. However, under present conditions, it has been found that there are times when the tank must be heated especially for cleaning a small number of parts. This, of course, is expensive. It is much cheaper to have one man clean these parts with the gun. It often happens also that it is necessary to hand clean large parts, such as pony trucks, because they are too large to go into the tank or that there is no room in the tank for them. The steam gun can be used to advantage on his type of work also.

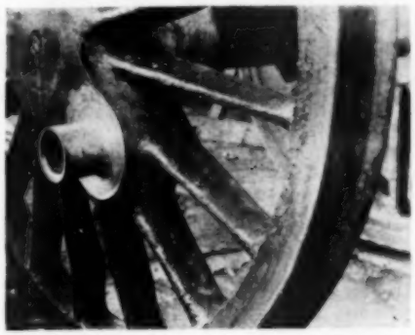
Certain equipment, such as air compressors, intercooler coils, and reservoirs, may be thoroughly cleaned without going to the expense of tearing down. The general method of cleaning this equipment is to circulate a boiling solution of the cleaning material through parts to be cleaned. As an instance of the saving made in this manner, we will take an average air compressor. Using equipment which may be obtained on the market, a dirty compressor may be entirely cleaned in one hour's time. The cleaning solution, which is mixed at eight ounces of cleaning material to each gallon of water, may be used by circulating either in vapor form or as a boiling liquid.

The brass parts of air pumps, lubricators, injectors and especially old globe valves may be cleaned, and the brass surface left bright, by installing equipment and cleaning materials as shown on line drawing. This is an inexpensive layout that may be made mostly of salvage material. Reconditioned valves alone will pay for this equipment in a short time. While valves cleaned by average scrubbing methods will be all right mechanically, the mechanic does not care to use them because of the dirty second-hand appearance of the brass.

As an example of the saving made by this layout the following facts speak for themselves; Let us take, for example, the cleaning of the brass parts of an 8½-in. cross-compound air compressor, which contains sixteen separate brass parts consisting of receiving and discharge cages, packing nuts, glands, etc. The usual method is to clean by hand filing and machine sanding; this takes one man two hours. To clean the same parts by the layout illustrated takes one man 20 minutes and does a superior job.

The exhaust steam carries with it carbon and oil which causes a carbonized surface on the outside of the tubes, forming the tube bundles, as well as on the baffle plates and inside wall of the heater. A former method was to take it off the locomotive and to boil in a mixture of one of the solvents. This method does not clean the inside tube of the bundle well, and besides, there is considerable fire hazard.

The up-to-date method of cleaning these heaters is to make up a 150-gal. steel tank and mount it on wheels so it may be moved from one locomotive to another. Disconnect the exhaust steam pipes above the cylinder head, and baffle these connections off with copper plates so the solution will not run into the cylinder. Disconnect both drains to the tender and assemble a drain valve on each connection. Now all that is necessary is to connect the steam side of the heater, using flexible rubber hose for the purpose, to the tank and pump. Connections should be made in such a way that the pump will take suction from the tank. Circulate the solution through the steam side of the heater and deliver it back to the tank. A steam coil is furnished in the tank to keep the solution at or near the boiling temperature. The tank should be charged with the proper materials to be used for this class of work mixed up at a strength of eight ounces to each gallon of water. The length of time of circulating the solution will vary but will average from eight to twelve hours. This means a large saving in labor to say nothing of the better results obtained.

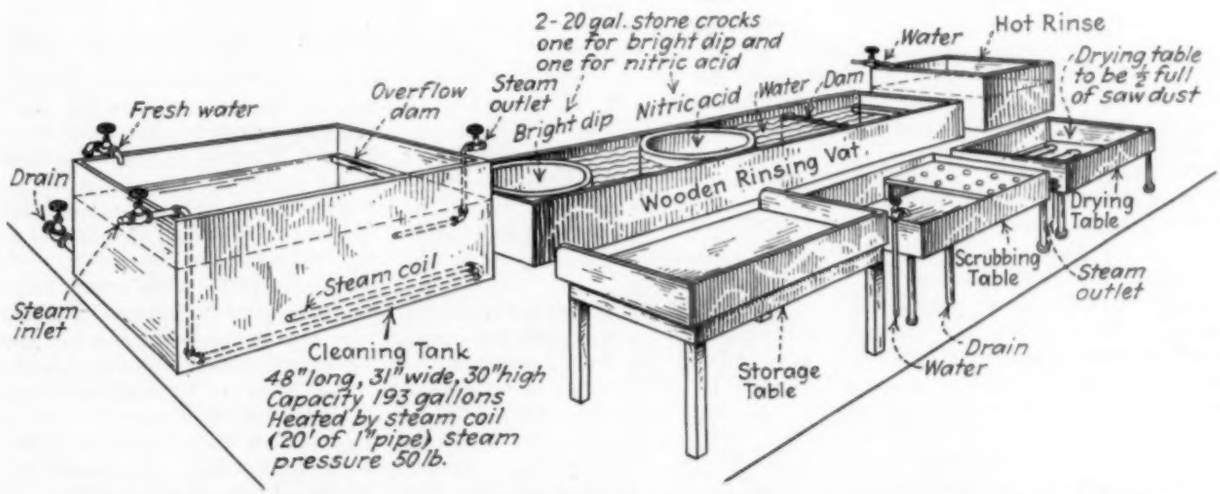


Paint jobs on drivers cleaned by the steam gun will last as long as the paint on the locomotive

Many methods are employed for cleaning locomotives, consisting of spraying with a solution of distillate, oil, or by hand wiping. The work is usually done during the ten minutes or so that the locomotive is held at the ash pit.

Because of the oily nature of the cleaning material, when cleaning as above, the surfaces are covered with a film, which attracts dust, forming a muddy and slippery surface. This oil gradually dries, leaving a gummy film over the whole surface.

The latest method, which has been adopted by many of the roads, is to clean by the steam gun method, using the equipment mentioned previously; it



Parts are placed into baskets of iron wire mesh for the first cleaning or grease tank and into baskets of aluminum or copper wire for the acid dips

has been found practical to use a much weaker solution than where frames are cleaned. Steam pressure of 70 lb. is most advantageous. Two guns are used operated by one man on each side of the locomotive. When two operators clean for ten minutes, the total cost of solution is from five to seven cents. Where this method of cleaning is installed, it is not usually the practice to try to clean the locomotive down to the painted surface in one cleaning; it would take entirely too long. It has been found that each ten-minute cleaning by this method removes some of the gummy, oily deposit from the surfaces, and that after a month or two, the power is in clean condition. Then the operator has time to clean the more inaccessible parts, such as driving boxes and edges of the frame, in order that possible fractures in the metal may be detected. This last is important from a safety standpoint. Electric locomotives are cleaned with the steam gun with first class results.

Cleaning preparatory to repainting may be divided into two classes:

1. Where the old paint is in good condition and only a coat of color or varnish is to be applied over it.

2. Where the paint has been scratched and parts of it have chipped off.

There is another class of painted surfaces where the paint has to be entirely removed down to the original surface.

The steam gun is a real time saver in removing the heavier deposits of dirt from the lacquered sides of tenders and other surfaces, preparatory to refinishing. After going over the surface with the gun, it is necessary to brush it off with rinse water.

Where the painted (not lacquered) surface of pullman and passenger coaches are in good condition and need only to have a color coat or varnish applied for refinishing, the steam gun is not recommended. It is better to clean this surface by the old method of brushing down with scrub brushes and various solvents.

Where running gear, such as drivers and other similar painted parts, are to be repainted, cleaning is usually done by scraping off all the grease possible and rubbing down with distillate or similar material. After this, the coat of paint is applied by a spray. The trouble with this method is that there are a great many greasy areas left on the old paint. After the new coat of paint is applied, it soon falls off these greasy areas leaving a job worse than before.

Where the power has been washed at the ash pit for a period of a month or two, as mentioned above, the painted surfaces are so clean that they may be easily prepared for repainting by merely going over them once with the gun. This last cleaning operation will remove every vestige of oil and grease. It will be found that the paint will not flake off as when applied over an oily or greasy surface.

The method in use in preparing drivers for repainting depends upon the equipment at hand. All the old paint may be removed by sand blasting or boiling out in the large back shop tank. Where roads have no facilities for doing the work in this manner, they usually "clean" the work by hand scraping. The length of time consumed is about the same or less than that used in cleaning the drivers with a steam gun. However, there is no comparison in the cleanliness of the final surface obtained. When the hand scraped driver is spray painted, paint does not adhere over the greasy surfaces, and each time they are cleaned, some of this paint is removed.

When the drive is steam cleaned whatever paint is left adheres perfectly to the metal surface, and any paint applied on a greasy surface is removed by the force of the jet. When this driver is repainted, it is necessary to cover the bare metal spots with a sand knife undercoating. While this will cost more than the former painting operation, there is no comparison in the final appearance.

The actual removal of all paint from locomotive tanks, coaches, and other equipment is an expensive job. Where there is a quantity of this work, it is usually done by what is known as the flow-on method or by sand blasting the surface. Good results are obtained by both of these systems, but the initial cost of equipment is too great for the average shop. Within the last two years a simple system, using inexpensive equipment, has been developed.

The apparatus consists of a portable tank, holding the hot stripping solution, and a method of forcing it under low pressure against the side of the tank or coach being stripped. The same solution is used over several times and costs about five cents per gallon.

A 70-ft. steel coach may be stripped down to the metal including vestibules in about 70 man-hours; two men are usually employed; the stripping material consumed amounts to from eight to nine dollars. The metal is left in good condition for either a future paint or lacquer job. The total time consumed in stripping the average locomotive tank by two men is one day.

Washing at the ash pit for appearance only is performed quickly and thoroughly with a steam jet

Gages for Air Brake Inspection

If the use of gages indicates improved practice as most engineers feel, the railroads are about to take a decided step forward. The New York and the Westinghouse Air Brake Companies have perfected a set of gages to be used in the inspection of air brake valves for the use of air brake men in determining quickly when vital parts can be successfully salvaged, or must be scrapped. For no railroad man intentionally uses any part of the air brake mechanism that will not give perfect service. These gages are simple in design and construction and will save a lot of time in the repair of air brakes, as well as insure even more reliable service. It should be remembered, however, that gages wear as well as parts and should be checked periodically.

Change Gears for Gear Cutting

Discussion

T. R. RIDEOUT

Westinghouse Electric & Manufacturing Company, Nuttall Works

Brocots' tables applied to a troublesome problem give accurate results without intricate calculations

SEVERAL articles have appeared in *American Machinist* which described different methods of determining change gear ratios (Vol. 74, pages 403 and 943; Vol. 75, page 601; Vol. 76, page 134). The problem of finding change gears is a common one and yet, at times, can be extremely troublesome. In view of the commonness of the problem and the apparent widespread interest, another method of solution should not be superfluous.

The method described in this article is one that I have used to the exclusion of all others with complete success. No credit is claimed for its originality, but to the best of my knowledge it has never before appeared in print and is not, I believe, widely known.

One advantage claimed for this method is that no intricate or lengthy calculations are involved. The chance of obtaining an approximate fraction containing a prime number cannot be avoided in this or any other method of solution. However, the ease with which the approximate fraction is found makes the finding of a prime number much less discouraging than it might be. A further advantage lies in the fact that the degree of accuracy of approximation is always apparent and under direct control. There is no possibility of working blindly in order to obtain an approximate fraction which, in addition to the possibility of containing a prime number, may not be within the desired limit of approximation. By this method, one works from the closest approximation, obtained by inspection, towards the allowable limit of error. It is at least an even chance that an approximation will be found which is closer to the original ratio than it is to the error limit.

Limit of Accuracy

Before starting a problem of this kind, it is well to determine what the effect of an error will be (whether cumulative or decreasing) and to fix an allowable error based on the ultimate permissible variation. An allowable error of plus or minus 0.00001 is used in the explanation because it is in line with common practice. A set of change gears, having an error well within that limit, was found at the third trial, and the total time consumed was not over ten minutes. A second set having an error of only 0.00000129 was also found, but with considerably more difficulty. Without doubt even closer approximations are possible, but it is questionable as to whether the benefits obtained justify the time involved.

This method is based on the use of Brocots' tables of decimal equivalents of fractions. The tables are published in handy booklet form by the Gould & Eberhardt Company and may be obtained from them for a nominal sum.

Most problems of this kind are in decimal rather than fractional form to start with, and the use of the tables may show a fraction having a decimal equivalent close enough to that required so that no further work is necessary.

In the explanation which follows I have used the same fraction, 24/113, used in the previous articles.

Ratio given: $\frac{24}{113} = 0.21238938$

Allowable error: $\pm$ 0.00001

$$0.21238938 \pm 0.00001 = \begin{cases} 0.21237938 \\ 0.21239938 \end{cases}$$

Referring to the table of decimal equivalents, we find that the nearest decimal given is 0.21250 (17/80) which is not close enough—the error being 0.000111.

Let us multiply the given decimal by 10. If the original number is greater than unity (for example: 7.29654) we would divide by 10.

$$10 \times 0.21238938 = 2.1238938$$

Looking up the decimal portion of the preceding number in the table of decimal equivalents, we find that there are no fractions having decimal equivalents which lie within the limits of error previously given.

Multiplying by 100:

$$100 \times 0.21238938 = 21.238938$$

the following fractions have decimal equivalents which approximate the decimal portion of the above number within the desired limits:

	Difference	*Error*
5/21 = 0.238095	0.000843	0.00000843
21/88 = 0.238636	0.000302	0.00000302
16/17 = 0.238805	0.000133	0.00000133
11/46 = 0.239130	0.000192	0.00000192
17/71 = 0.239436	0.000498	0.00000498
23/96 = 0.239583	0.000645	0.00000645

First trial

Selecting the fraction that gives the least error, add it to the integral portion (21) of the irrational number 21.238938, and we have the mixed number:

$$21\ 16/67 = 21.238805$$

Converting into an improper fraction:

$$21\ 16/67 = \frac{(21 \times 67) + 16}{67} = \frac{1423}{67}$$

As this fraction was obtained by multiplying the original number by 100 we must now divide by 100. We have $\frac{1423}{6700}$ which is a very close approximation to the original fraction 24/113. However, 1423 is prime so another fraction must be tried.

Second trial

The fraction 11/46 which gives the next smallest error also produces an ultimate fraction having a prime numerator.

Third trial

The fraction 21/88 gives the next lowest error. Adding to the integral portion of the original number, we have 21 21/88 which equals 1869/88 and, dividing by 100:

$$\frac{1869}{8800} = 0.21238636$$

Factoring we get

$$\frac{21 \times 89}{100 \times 88}, \text{ error } 0.00000302$$

The only other fraction within the range of error that does not produce an ultimate fraction having a prime numerator is 17/71:

$$\frac{21\ 17/71}{100} = \frac{1508}{7100} = \frac{29}{71} \times \frac{52}{100}$$

error 0.00000498

If closer approximations are desired, they may be obtained by multiplying the original decimal by 1000 instead of 10 or 100. That is not usually advisable, however, for the use of 1000 will give large numbers which are not as readily factorable as the smaller ones. If they are factorable, the factors are likely to be such that six change gears, rather than the usual four, would have to be used.

A better method would be either to multiply or divide the original decimal by a small integer (1, 2, 3, 4, 5, 6, 7, 8, 9) to give a new decimal and proceed as before. I have found it advisable to start with a large integer and work towards the smaller ones.

Multiplying the original decimal by 9 and then by 8 discloses no ratios having an error less than that previously found.

Multiplying by 7:

0.21238938
7

1.48672566

As we already have a set of change gears which give an error of only 0.00000302 and it is desired to find a closer approximation, 0.000003 will be used as the allowable error.

Multiplying the allowable error by 7 we get 0.000021. 1.48672566 ± 0.000021

$$= \begin{cases} 1.48670466 \\ 1.48674666 \end{cases}$$

Multiplying by 100 (10 having proved unsatisfactory in the previous trials of 9 and 8):

148.670466
148.674666

The table of decimals gives 18 decimals which are within the limits of error. For the sake of brevity they will not be listed here. Selecting the closest approximation and working from that we find, by trial, one whose ultimate fraction is factorable:

$$33/49 = 0.673469$$

$$148\ 33/49 = \frac{7285}{49};$$

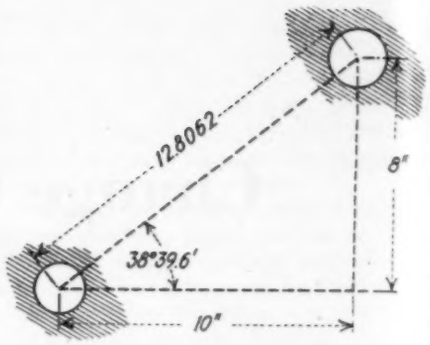
dividing by 100: $\frac{7285}{4900}$

Since we multiplied the original decimal by 7 we must now divide by it:

$$\frac{7285}{4900 \times 7}$$ Factoring we get:

$$\frac{31 \times 47 \times 5}{49 \times 100 \times 7} = \frac{47 \times 31}{98 \times 70}$$

$= 0.21239067$, error $= 0.00000129$



tolerance of only 0.00029 in.—about one-quarter of a thousandth. The interpolation is given in simple fractions of a minute.

This table may be easily memorized as the maximum tolerance fortunately works out so that the fraction of a minute in each case is simply the reciprocal of the longest side in inches.

An example is given in the accompanying sketch. The base and altitude are given as 10 in. and 8 in. respectively. It is required to compute the hypotenuse by first determining one angle in terms that will keep within the desired limits. From Table I, it is apparent that the angle must be interpolated to an accuracy of tenths of a minute. Figuring on this basis, the value is fixed at 38 deg. 39 min. plus an additional 0.6 min. Using this angle the hypotenuse is figured as 12.8062 in., which is precise to the limits set.

But had we been content to call the angle 38 deg. 40 min., the nearest value given in most tables, we would have obtained a result of 12.8075 in., a difference of 0.0013 in., which is not permissible because the boring tolerance itself is only 0.002 in.

Inspection of Jig Bushing Holes

WALTER WELLS

In checking center distances, time may often be saved by first determining the degree of refinement needed in computing the subtended angles

TOOLMAKERS and floor inspectors, who have occasion to check jig bushing holes in series directly after horizontal boring while the job is still strapped to the machine table, are likely to have some trouble when computing the direct center-to-center diagonal dimension between holes, unless they have some means of limiting the amount of interpolation.

On small jobs, the 1-min. divisions on regular trigonometric tables are good enough even for precision work. But on jobs, where the center distance between holes is three inches or over, significant errors will creep into the calculation. This is because the length of the arc varies in direct proportion with the length of the sides of the subtended angle. When the computation for the angle does not come out even in degrees and minutes, the difference will cause an error unless taken into consideration. For example, if the sides are 20 in. long, a difference of one-half minute will cause an error of 0.003 in. in the side.

At first thought, the solution would seem to be to interpolate the angle in terms of seconds of an arc. However, this is going to the other extreme, for in most instances, the result would be far more precise than necessary. To simplify the computation, Table I has been worked out. This shows the degree of refinement for the angular measurement required in relation to the lengths of the side of the angle to give a maximum

Table I

Longest side in inches	Interpolation in fractions of a minute
1	1
2	½
4	¼
10	0.1
30	1/30 (2 sec.)

When using an optical dividing head, its limits of accuracy should be kept in mind. For instance, if the instrument will read accurately to 0.5 min., the following error in computation may be possible.

Table II

Radius in inches	Possible error in inches
2	0.0008
5	0.0007
10	0.0015

Contour Calculations for Forming Tools—IV

Internal forming tools is the subject of the fourth installment of the author's analysis

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Chief Tool Designer,
Tyson Roller Bearing Corporation

MANY a job, having intricate internal profiles, has been passed up as unmachinable, or not practical for the shop to put on a production basis, because not enough is known about the design and calculation of forming tools.

Previous articles explained external forming tools, feeding at 90 deg. to the center line of the product. The rake of those tools may be ground parallel with the center line of the tool, unless it is important to have the longest surface on the product perfectly straight. If this is the case, the rake of the tool should be ground at an angle with the center line of the tool in order to bring the important points on the tool up to the center line of the product (*AM*—Vol. 76, page 894, Figs. 1 and 2).

It has been found essential to have internal circular forming tools cut on center for all points on the longest surface of the work whenever the angle that this surface makes with the center line of the work is relatively small. To do this, it is necessary to grind the top rake out of parallel to the axis of the tool as described for external forming tools. When the angle is relatively large, the same practice may be desirable to give a better shearing effect to the cutting edge. However, this is not always necessary, and in such cases, the tool may be ground with the top rake parallel to its axis. Experience has shown that the limiting condition between these two methods of grinding the top rake is when the longest surface of the work is approximately 45 deg.

The diameter of internal circular forming tools should not be greater than three-quarters the smallest diameter to be formed, and the periphery clearance angle which we made 5 deg. for external circular forming tools, should not be less than 10 deg. The rake angle should be varied according to the steel to be machined.

We shall first calculate a circular forming tool, the rake angle of which is to be ground parallel with the center line of the tool; then we shall calculate a circular forming tool with a rake angle

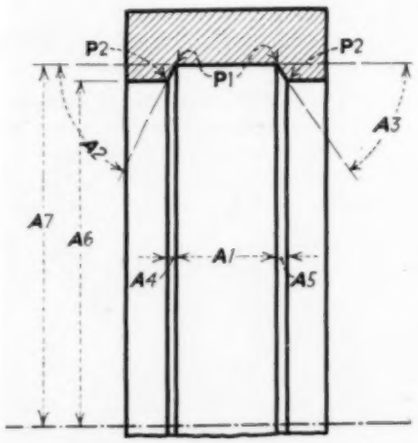
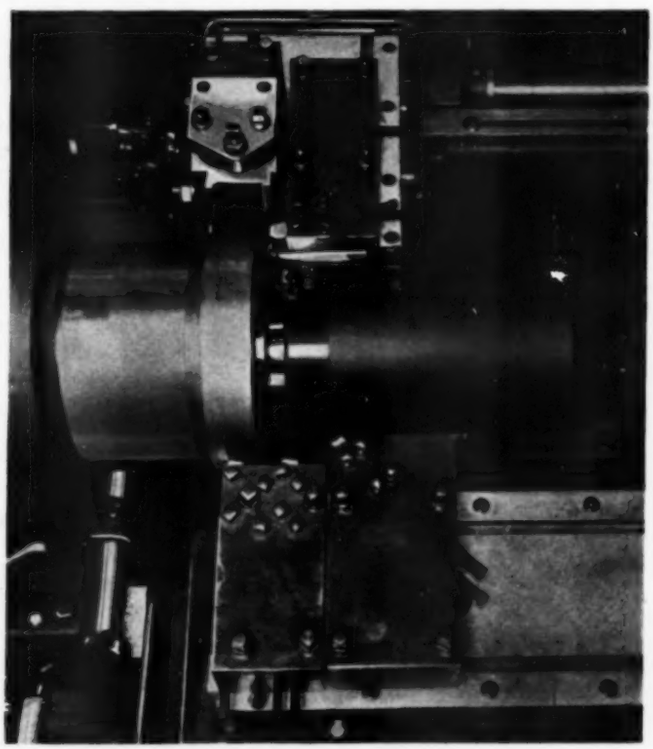


Fig. 27—Since the principal surface of this part is parallel to the axis, the rake on the forming tool may be ground parallel to its axis



On a P&J automatic, a flat forming tool is used to finish the outside surface of a roller bearing cup

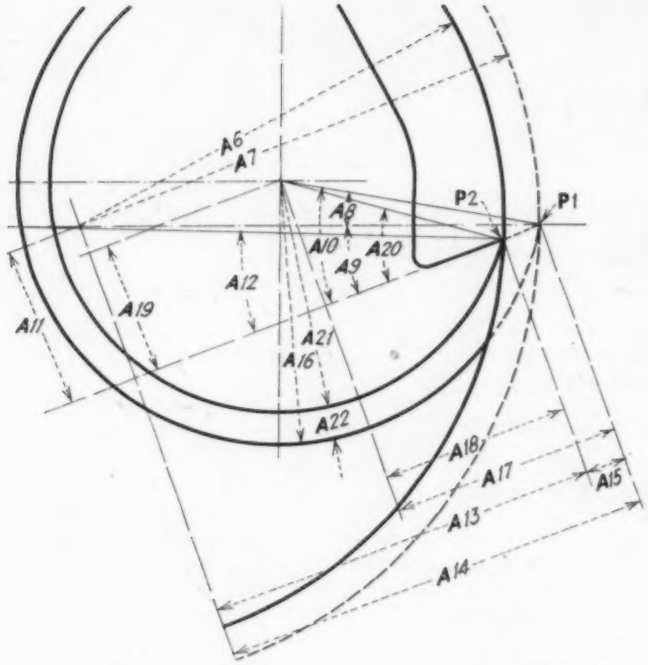


Fig. 28—Laying out the forming tool in relation to the product enables the tool calculation for the work shown in Fig. 27

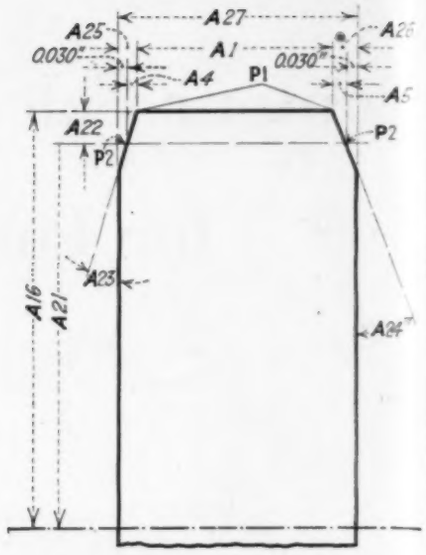


Fig. 29 — From the layout, the dimensions on this internal forming tool may be derived

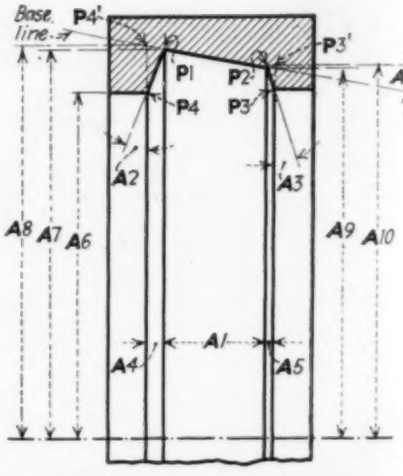


Fig. 30—The angularity of the main internal surface of this part makes it advisable to grind the forming tool with a rake that will keep Points 1 and 2 on the center line

ground at an angle with the center line of the tool.

Fig. 27 shows a part to be machined internally by a circular forming tool. Dimension *A1* is parallel with the center line, and angles *A2* and *A3* are both greater than 45 deg. Therefore the rake angle of the tool may be ground parallel with the center line of the tool. Fig. 28 is an exaggerated sketch of the tool in finishing position, and Fig. 29 is a layout of the tool profile.

The tool calculations follow:

$A8$ = periphery clearance angle
$A9$ = rake angle
$A8 + A9 = A10$
$A7 \times \sin A9 = A11$

$$\frac{A11}{A6} = \sin A12$$

$A6 \times \cos A12 = A13$
$A7 \times \cos A9 = A14$
$A14 - A13 = A15$
$A16$ = radius of the tool at Point 1
$A16 \times \cos A10 = A17$
$A17 - A15 = A18$
$A16 \times \sin A10 = A19$

$$\frac{A19}{A18} = \tan A20$$

$$\frac{A18}{\cos A20} = A21$$

$A16 - A21 = A22$

$$\frac{A4}{A22} = \tan A23$$

$$\frac{A5}{A22} = \tan A24$$

$A4 + 0.030 \text{ in.} = A25$
$A5 + 0.030 \text{ in.} = A26$
$A26 + A1 + A25 = A27$

Fig. 30 shows another product to be internally machined by a circular forming tool. Fig. 31 is an exaggerated sketch of the tool in finished position, and Fig 32, is a layout of the tool profile.

Angle *A11* in this case is less than 45 deg., and consequently the rake of the tool has to be ground at an angle with the center line of the tool in order that the tool may produce a straight line between Points 1 and 2. It is also necessary to grind the tool this way so that we will obtain the proper periphery clearance.

Just as for external forming tools previously described (*AM*—Vol. 76, page 930), we have to establish a base line on the product before we can go ahead with the tool calculations. Where this base line intersects lines drawn through the points, which do not fall on the base line perpendicular to the center line of the product, we will obtain new Points 3′ and 4′.

If the rake angle of the tool is ground in such a way that Point 2 as well as Point 1 falls on the center of the work, we know that any other point on the base line also will fall on the center line of the work.

The distance from Points 3′ and 4′ to the center line of the product should then be calculated. Calculations for this type of tool are as follows:

$A12$ = periphery clearance
$A13$ = rake angle
$A12 + A13 = A14$

$A15$ = radius of tool at Point 1
$A15 \times \cos A12 = A16$
$A7 - A16 = A17$
$A7 - A10 = A18$
$A18 \times \sin A13 = A19$

$$\frac{A19}{A1} = \tan A20$$

$A20$ = vise angle
$A10 - A17 = A21$
$A15 \times \sin A12 = A22$

$$\frac{A22}{A21} = \tan A23$$

$$\frac{A21}{\cos A23} = A24$$

$A9 \times \sin A13 = A25$

$$\frac{A25}{A6} = \sin A26$$

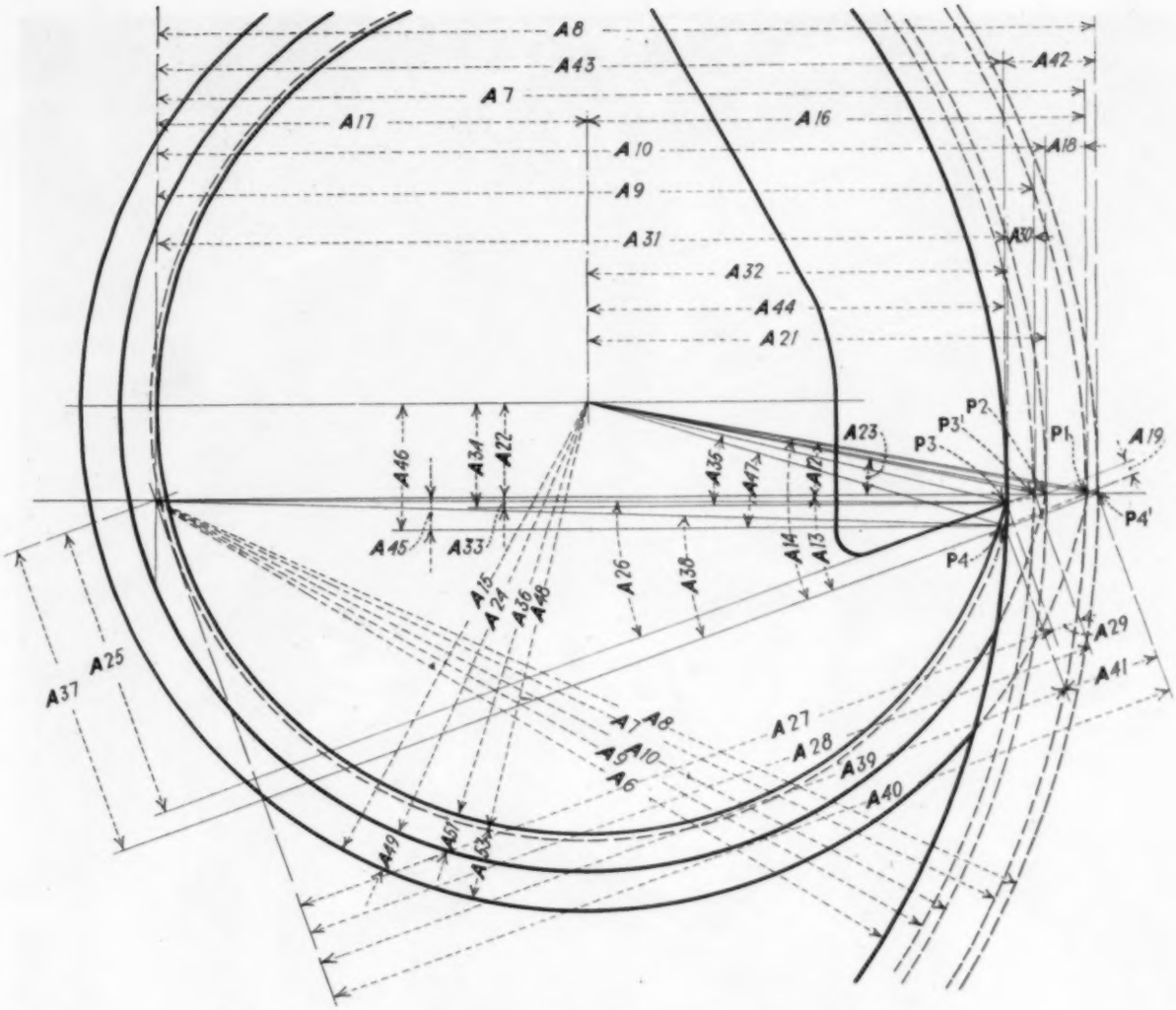


Fig. 31—When a compound rake angle is employed, the layout becomes more complicated, but accurate profile dimensions can still be calculated

$A6 \times \cos A26 = A27$
$A9 \times \cos A13 = A28$
$A28 - A27 = A29$
$A29 \times \cos A13 = A30$
$A9 - A30 = A31$
$A31 - A17 = A32$
$A29 \times \sin A13 = A33$
$A33 + A22 = A34$

$$\frac{A34}{A32} = \tan A35$$

$$\frac{A32}{\cos A35} = A36$$

$A8 \times \sin A13 = A37$

$$\frac{A37}{A6} = \sin A38$$

$A6 \times \cos A38 = A39$
$A8 \times \cos A13 = A40$
$A40 - A39 = A41$
$A41 \times \cos A13 = A42$
$A8 - A42 = A43$
$A43 - A17 = A44$
$A41 \times \sin A13 = A45$
$A45 + A22 = A46$

$$\frac{A46}{A44} = \tan A47$$

$$\frac{A44}{\cos A47} = A48$$

$A15 - A24 = A49$

$$\frac{A49}{A1} = \tan A50$$

$A24 - A36 = A51$

$$\frac{A5}{A51} = \tan A52$$

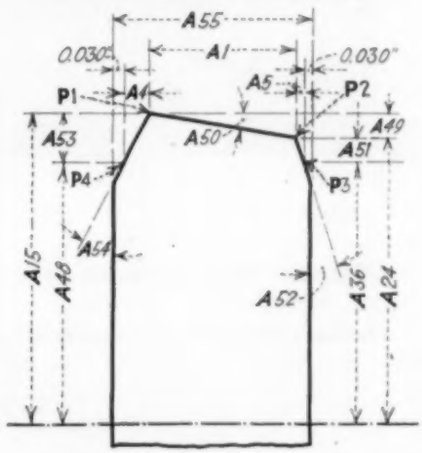
$A15 - A48 = A53$

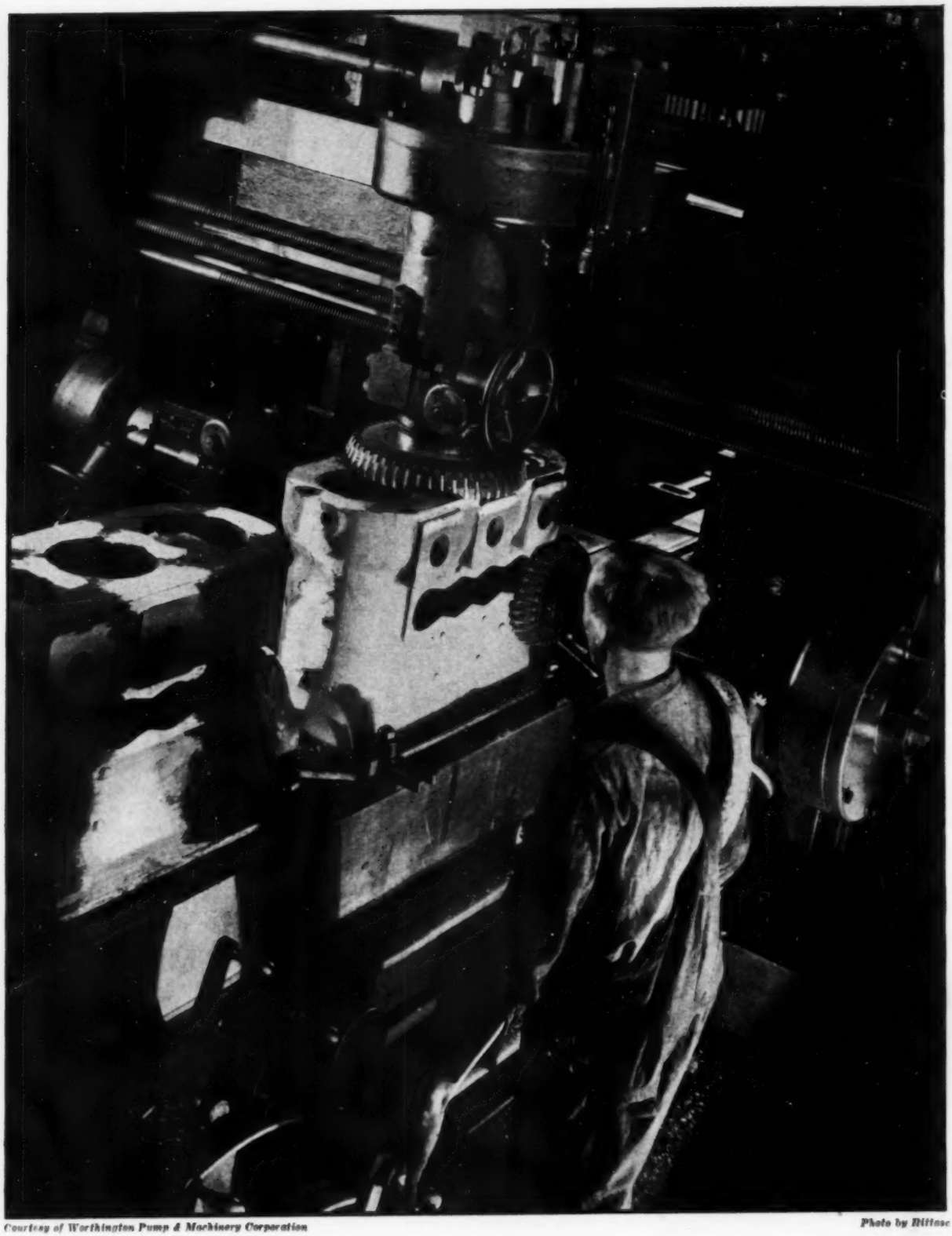
$$\frac{A4}{A53} = \tan A54$$

$A1 + A4 + A5 + 0.060 = A55$

For the application of logarithms to the calculation of form tool contours see the first article of this series (*AM*—Vol. 76, page 896).

Fig. 32—Dimensions calculated for a tool for machining the product shown in Fig. 30 compensate for the variations introduced by the use of a compound rake angle





Courtesy of Worthington Pump & Machinery Corporation *Photo by Bittner*

Metallic bites by teeth of hardened steel

follow the precise control of man and machine

EDITORIALS

AMERICAN MACHINIST
VOLUME 76 ESTABLISHED 1877 NUMBER 31
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K. H. CONDIT F. H. COLVIN
EDITORS

The Robertson Committee

Rapid progress marks the organization of, and development of plans for, the Robertson Committee. As reported in the last issue of *American Machinist*, this committee is charged with responsibility for industrial rehabilitation. It is a sub-committee of the general reconstruction organization headed by Henry M. Robinson.

While a definite program for the activities of the committee has not been announced, as this is written, we understand that regional sub-committees will be set up to further the general aims in their respective districts. A prominent industrial executive is to head each of the regional groups, and he will have associated with him a vice-chairman who will be chosen from the ranks of the machinery industry wherever possible. In one district the chairman and vice-chairman have already planned a three weeks' automobile tour of their district to set the wheels in motion.

Among the tasks facing the district organizations are surveys of the extent of obsolescence in their districts and estimates of the needs for credit to finance replacements, steps toward relief of the prostration in the machinery building industries, creation of employment in these industries, and stimulation of general business recovery.

One of the best ways to accomplish the main objective would be to persuade the bell-wethers of each district to abandon their reactionary attitude toward machinery purchases, and where the necessary funds or credit are available, to induce action toward the placing of orders for much-needed self-liquidating equipment. Ninety-nine plants out of a hundred really need modern machinery in some departments if not in all. Managers of most of them have held back because of lack of credit, dislike of impairing the liquid condition of their surpluses, or because of failure to recognize the danger of continuing to depend on obsolete equipment on the chance that their competitors are doing the same thing.

In changing this defeatist psychology the Robertson Committee and its regional sub-committees face a Herculean task. They must convert the industrialist and they must also convert the banker, if they are to get results. They will need the cooperation of every man in the machinery industry. Once their purpose is understood we are convinced they will get it.

No government money is as yet available for the financing of this replacement. Political maneuvering blocked one channel, fiscal orthodoxy blocked another. Perhaps the most effective obstacle was the dislike of the manufacturer for any form of subsidy or loan that would open his books to federal bureaucrats and offer an opportunity for further entry of government into business. No matter how well justified this attitude was, or is, for it still exists, the fact that it does exist is sufficient.

It may well be that the only practical solution will be formation of one or more machinery financing corporations. A railroad equipment financing corporation has been formed to take care of a somewhat similar situation in the railroad field. Perhaps the machinery men could pattern one of their own on this one. It seems more than probable that such a corporation would be able to discount its loans with the big banks if it had sufficient strength. And with the whole machinery industry behind it there is no reason why it should not be stronger than the railroad financing body, with the sole exception that this corporation has R.F.C. connections.

Whatever the practical means of financing finally devised we urge on every individual in the industry careful consideration of every move made by this committee. It is now the nucleus of the effort to rehabilitate our industry. Around it must gather the best thought and endeavor of everyone concerned.

And while the plans are taking shape the wise manager of every plant where machinery is used will be studying his own equipment to discover where he is vulnerable to the atacks of better equipped competitors, and deciding how he is going to defend himself.

Reasonable Delivery Helps Spread Work

We all hail with joy any report of increased activity in industry, and fortunately, reports of better business are becoming more frequent. But managers in all lines should bear in mind that the greatest good will come from spreading work as far as possible and that sudden spurts that require overtime work are not desirable, especially now.

Buyers of either capital or consumer goods can help greatly by being reasonable in their demands for delivery. While this is no time to dictate to customers, the manufacturer can assist by pointing out the desirability, from every point of view, of running shorter hours and spreading the work over a longer period. Overtime and night work should be avoided.

Nearly all progressive managers and leaders in industry are agreed that the work week of the future will be materially shorter than in the past. While a thirty-hour week seems a drastic step it is being advocated by many conservative manufacturers as a practicable

way of lessening the likelihood of a recurrence of depression.

It will be well to get the idea of the shorter work week into our minds and to readjust our ideas to it. Wage adjustments will take care of themselves. The main thing is to get workers back on the job.

Scrap or Keep?

What will become of the old machinery now stored in warehouses and factories when business has increased to the point where replacement can no longer be avoided? J. Roy Porter, in an address to the machine tool dealers, declared that many of these tools would never go back into service.

If that statement is correct there are but two alternatives for their owners: Scrap or keep. Automobile dealers have faced a similar situation. Some chose to scrap their worthless traded-in cars, others chose to keep them. Most of the first group are still in business, most of the others are not.

The choice lies between carrying on a business and supporting a museum. Museums are entertaining, at times, but seldom continuously profitable.

CHIPS

Railroad equipment financing corporation formed by leading equipment companies to speed up loans for railroad modernization . . . Robertson Industrial Rehabilitation Committee starts to function . . . Chairman urges placing of orders for materials and machinery . . . Commodities Finance Corporation makes its first loan . . . R.F.C. defines self-liquidating projects, liberally and at length . . . is ready to handle loans for carrying raw materials, assistance to agriculture, loans to railroads, and self-liquidating construction . . . Pennsylvania R.R. applies for $2,000,000 to build steel box cars . . . B. & O. asks for $3,000,000 . . . Coordinated effort to spread work gets under way . . . Teagle and Walker, in charge of it, have applied principle successfully in their own companies . . . Directors of American Petroleum Institute indorse 40-hour week idea . . . Newton D. Baker to head relief conference to be held at Washington September 15.

Certain old-school economists condemn present measures for reflation as suicidal artificial inflation . . . sure to be followed by worse conditions . . . if reflation is artificial it is at least amazingly effective in cotton and textiles, grain and rubber . . . Leading textile machinery firm looks over its books and finds that frantic rush orders for repair parts have always forecast recovery . . . reports a deluge of telephone and telegraph orders for repair parts since August 15 . . . Treasury issue of $1,150,000,000 oversubscribed . . . Steel activity increases, doubling in Cleveland district . . . Ford reopens main plant and Hamilton, Ohio, unit . . . Willys-Overland resumes with 4,300 men . . . Railroad heads meet to discuss wage cut, union leaders not invited . . . Electric power output approaches nearer to 1931 figures . . . Electric railway men will discuss progress of research in standard car design at Chicago meeting . . . Small tool manufacturer finds orders smaller but more numerous in August.

> Some bankers are so set on liquidity that they remind one of a fat man's collar on a hot August day. They are just about as popular.

Golden Gate Bridge to be started this fall . . . New Orleans bridge likely to be first self-liquidating project to get loan from R.F.C. . . . *Engineering News-Record* index of volume of engineering construction drops from 166 in July to 111 in August . . . was 187 a year ago . . . cost of construction materials index rises slightly . . . Prices of copper, lead, zinc and tin continue advance . . . Metal and Mineral Markets index of non-ferrous metal prices rose from 44.77 in July to 47.32 in August . . . 58.05 in August 1931 . . . producers of silver gradually awakening to importance of industrial uses . . . Japanese metallurgist announces new magnet steels with greatly improved characteristics.

Germany announces reconstruction program . . . apparently based on belief that worst of depression is over . . . securities markets rise in sympathy . . . state socialism becoming an accomplished fact . . . England muddles along with a textile strike that looks serious . . . France expects to convert $3,000,000,000 war loan in October . . . prospects for new trade agreements with U. S. fade . . . Japan struggles with pressing relief problem, threatened renewal of boycott by Shanghai merchants, big road building program in Manchukuo.

> Census Bureau tells us that half of us worked in 1930, practically no change from 1920. At least half of us would still like to work, and we are not so particular about the kind of work as we were.

Maytag wins patent suit and arranges licenses for other washing machine makers . . . generally considered a healthy thing for the industry . . . Frigidaire adopts aluminum foil insulation . . . cuts price $30 . . . New non-run hosiery apparently makes a hit . . . Sherwin-Williams announces million-dollar advertising campaign . . . Reading R.R. shops recall 2,000 . . . Lackawanna adds engine crews to handle growing traffic . . . Illinois Central has steady work for another 1,000 men.

Woodin Heads Railroad Financing Group

On September 8, the Railroad Equipment Financing Corporation was organized, and William H. Woodin, president of the American Car and Foundry Co., named as chairman of its board. The primary purpose of this unit is to end the curtailment of railroad purchases that has persisted for the past three years by means of making available to the railroads the $300,000,000 credit which the Reconstruction Finance Corporation has available for rehabilitation purposes. Associated with Mr. Woodin on the board of the new corporation is the following group of prominent industrialists representing the country's leading equipment manufacturers:

SAMUEL G. ALLEN, president of Lima Locomotive Works.

GEORGE B. BALDWIN, vice-president of General Electric Co.

WILLIAM C. DICKERMAN, president of American Locomotive Co.

HARRISON HOBLITZELLE, president of General Steel Castings Corporation.

GEORGE H. HOUSTON, president of Baldwin Locomotive Works.

MYLES B. LAMBERT, president of Westinghouse Electric and Manufacturing Corporation.

C. A. LIDDLE, president of the Pullman Car & Manufacturing Corporation.

J. E. MACENULTY, vice-president of the Pressed Steel Car Co.

R. E. MCMATH, vice-president of Bethlehem Steel Corporation.

GEORGE E. SCOTT, president of American Steel Foundries.

LESTER N. SELIG, president of General American Tank Car Corporation.

In addition to the above, Robert P. Lamont, president of the Iron and Steel Institute, and Harry A. Wheeler, president of the Railway Business Association, will also serve as directors.

As an intermediary between the railroads and the R.F.C., the corporation will entertain applications for loans with which to construct practically all types of railroad equipment and rolling stock such as locomotives, rails, freight and passenger cars.

In 1927 a total of $1,395,928,000 was spent by the railroads for material, supplies and for fuel of which approximately $450,000,000 went into iron and steel products. For 1931 it is estimated that $695,000,000 was spent for such purposes with approximately one-third going into the purchase of iron and steel products as follows:

Steel rail (except scrap)	$50,800,000
Wheels, axles and tires	22,000,000
Frogs, switches, crossings, track fastenings and bolts, spikes, tie plates, rail anchors, etc.	40,500,000
Iron bridges, turntables, structural steel bar iron and steel, forgings, fabricated and unfabricated shapes and pressed steel parts	30,500,000
Flues and tubes for boilers	4,200,000
Telegraph and telephone interlocking and signal material	10,000,000
Bolts, nuts, washers, rivets, springs, etc.	10,000,000
Locomotive and car castings, beams, couplers, frames and car roofs	29,300,000
Machinery, boilers, repair parts and all other iron and steel products	22,700,000
Total iron and steel products	$220,000,000

These figures reflect the decline from a normal year which the newly formed corporation will endeavor to correct.

Rehabilitation Committee Urges Equipment Replacement

According to a statement by A. W. Robertson, chairman of the recently formed committee on industrial rehabilitation, one solution to the problems of employment and business recovery lies in the direction of industrial modernization. Outlining the purposes of this committee, Mr. Robertson said in part:

"In the industries devoted to the making of machinery and equipment alone, approximately 1,620,000 workers have been deprived of employment since 1929. Their loss in income totals more than three billions of dollars annually. It has been estimated in this connection that loss of employment for one worker in these 'capital goods' industries results in loss of employment for three workers engaged in the marketing of consumer products—food, clothing, radio, automobiles—or in furnishing materials to the equipment and machinery builder.

"The acuteness of this situation is further intensified by the fact that, along with the prostrating sag in employment, expenditures for equipment, machinery and plant facilities have dropped from the average normal annual outlay of $5,000,000,000 to a yearly total of $1,260,000,000. This falling off constitutes one of the major factors contributing to continuance of the paralysis which besets American industry at the present time.

"The progress of industrial maintenance has been interrupted to such a degree that today more than fifty per cent of the machinery, equipment and plant facilities in American factories is obsolete. The fact that in these last three years there has been more rapid improvement in equipment design than in any period in our industrial history makes the condition that much more urgent. Replacement has not kept pace with this engineering advance.

"The primary objective of the Committee on Industrial Rehabilitation at the present moment is to set in motion a succession of orders for improved equipment and machinery which will extend, in their effect on employment and spending, from the factory back to

• INDUSTRIAL REVIEW •

September did not begin with any rush of business for machinery men. No great hopes had been entertained for real orders, and apparently this feeling was justified. Underlying sentiment continues to improve, however, and this will certainly lead to some releases of pending business before long, particularly as the Robertson Committee is beginning to function.

Boston has seen no evidence of buying in the machine tool field but at least two of the big textile machinery companies have received encouraging orders for repair parts and new machines. Inquiries are picking up a bit in St. Louis and two of the makers of automobile accessories have orders comparing favorably with those of 1929. Other companies which resumed activity in August after vacation periods have had to step up working forces 10 per cent from the minimum.

Milwaukee finds orders scarce but is much encouraged by inquiries and general business indications. Steel jobbers report more orders and employment is up slightly. A company specializing in rebuilt tools got several substantial orders last week after months of quiet. A Chicago dealer booked an order for three machine tools, believed to be the first of any size since April. Inquiries are better. No orders of consequence have been placed in Cincinnati.

One Pittsburgh dealer reports receiving more inquiries in the last three weeks than in the previous three months. A few orders for small machines have been placed. Things are looking up a little in Detroit. The automobile plants have released some small orders and are preparing for greater activity this fall. Employment conditions are better and proprietors of metal-working plants are beginning to worry about how they will finance orders when they get them. In Cleveland a wire plant reopened giving work to 400 men. Other plants will resume shortly. Small metal-working shops are doing better and sentiment generally is improved. New York has no record of any orders that amount to anything but is watching closely for results from the activities of the Robertson Committee.

the farms, the forests and the mines. Every order starts a wave of work required in the production, processing, transportation, installation and sales of materials and services that is felt throughout all branches of business."

M. W. Alexander Dies

On September 10, MAGNUS WASHINGTON ALEXANDER, for the past sixteen years president of the National Industrial Conference Board, died at the age of 62 in his New York City home. Mr. Alexander was prominent as an engineer and as an authority on economics.

After studying engineering abroad, Mr. Alexander in 1893 became a designer for the Weston Electrical Instrument Co., and the following year joined the Westinghouse Electric and Manufacturing Co. In 1900 he entered the employ of the General Electric Co., an association that lasted eighteen years.

5-Day Week Studied

A special committee of the U. S. Chamber of Commerce started work on September 8 on an inquiry into the possibility of introducing the 5-day week in American industry. The proposal will be considered both as a means of relieving unemployment and from a long term viewpoint. A preliminary report is expected on September 23.

Machine Tool Orders Rise in August

For the first time since April, gross orders of machine tools for August showed an increase over the previous month. Advancing to 27.3, the index of orders, as reported by the National Machine Tool Builders' Association, rose two points above July. This was made up as follows: Index A (base more than $50,000), 27.3; Index B (base $10,000 to $50,000), 25.1; Index C (base less than $10,000), 34.4. The three months' moving average was 29.9.

The August index of shipments also rose, the average index being 29.5. Broken down by groups shipments were: Index A, 29.6; Index B, 27.1; Index C, 35.0. The unfilled order index was 77.2 for August, made up as follows: Index A, 67.2; Index B, 108.8; Index C, 103.2.

Poland Gets Russian Orders

An order for 50,000 metric tons of rolled steel, including 3,000 tons of dynamo sheets, 1,000 tons of transformer sheets and 4,000 tons of thin sheets was obtained by the Bismarckhuette, of Polish Silesia, from the Soviet Government according to press reports. Additional orders for 20,000 and 5,000 tons respectively are said to be pending placement in Poland.

For the past several months, the "Sovpoltorg," commercial agency for the development of trade between Poland and the U.S.S.R., has been negotiating for the sale of Polish-made railroad rolling stock to Russia, including 20 locomotives and 80 freight cars to cost about $50,000. The transaction is said to await credit agreement, the Soviet asking 28 months and the Polish mills being able to grant only 18 months with government support.

At this time, the Russian orders are particularly welcome because of the low state of the Polish iron and steel industries.

Metal Congress Presents Varied Programs

Under the joint auspices of six technical societies, the National Metal Congress will meet at Buffalo, N. Y. during the entire week of October 3. Tentative programs of papers to be presented are given below. At the close of the annual meeting of the American Society for Steel Treating the 1932 Campbell Memorial Lecture will be delivered by EDGAR C. BAIN of the United States Steel Corp. Research Laboratories. His subject will be "Factors Affecting the Inherent Hardenability of Steel."

A.S.M.E. MACHINE SHOP PRACTICE DIVISION

Adjusting Equipment Policies to Meet Changing Conditions, by KENNETH H. CONDIT, editor, *American Machinist* and *Product Engineering*.

The Influence of Oil Compressibility on Speed Characteristics of Hydraulic High Speed Presses, by WALTER ERNST, development engineer, Hydraulic Press Mfg. Co.

The Torque Required to Tap Cast Iron Using National Coarse Thread Series and National Fine Thread Series Taps, by J. E. MILLER.

Recent Trends in Machine Tool Design by GUY HUBBARD, formerly associate editor, *Steel*, Penton Publishing Co.

Technique of Size Control in Precision Grinding, by R. E. W. HARRISON, formerly chief engineer and director, Cincinnati Grinders Incorporated.

Design of Products to Utilize Die Castings of Machined Parts, by L. H. MORIN, Doehler Die Casting Co.

Materials for Modern Cutting Tools, by J. V. EMMONS, Cleveland Twist Drill Co.

A.S.S.T. PAPERS

Corrosion Resistance Of Iron Chromium Alloys in Various Media—The Salt Spray Test, by WM. B. ARNES and J. N. OSTROFSKY, Alloy Research Corp.

Observations on the Effect of Normalizing Medium Manganese Steels on the Microstructure and Physical Properties, by C. R. AUSTIN, Westinghouse Electric and Mfg. Co.

A Simple Cutting Tool for Measuring Pressures in the Direction of Cut, by O. W. BOSTON and C. E. KRAUS, University of Michigan.

Factors Influencing the Annealing of Cold Rolled Strip Steel, by G. R. BROPHY and L. L. WYMAN, General Electric Co.

Internal Friction In Iron and Iron Alloys, by ROBERT S. CANFIELD, U. S. Naval Research Laboratory.

Design of Heat Resisting Alloy Members and Their Performance in the Field, by RALF S. COCHRAN, Surface Combustion Co.

Further Experiments on the Forgeability of Steel, by O. W. ELLIS, Ontario Research Foundation.

Some Molybdenum High Speed Steels, by J. V. EMMONS, Cleveland Twist Drill Co.

The Role of Nickel in Nitriding Steels, by H. J. FRENCH, The International Nickel Co. and V. O. HOMERBERG, Massachusetts Institute of Technology.

An Interpretation of the Deep Acid Etch Test as Applied to Tool Steels, by J. P. GILL and H. G. JOHNSTON, Vanadium Alloys Steel Co.

Allotropy in Iron and Steel, by R. H. HARRINGTON, General Electric Co. and W. P. WOOD, University of Michigan.

The Manufacture of Stainless Steels, by E. R. JOHNSON and ROBERT SERGESON, Republic Steel Corporation.

Autographic Stress-Strain Curves of Deep-Drawing Sheets, by R. L. KENYON and R. S. BURNS, American Rolling Mill Co.

Development and Application of Macro-Etching, by H. G. KESHIAN, Chase Companies.

Routine Disk Inspection in Quality Steel Manufacture, by G. V. LUERSSEN, Carpenter Steel Co.

Lubrication of Deep Drawn Sheet Metal Parts, by H. A. MONTGOMERY, H. A. Montgomery Co.

Behavior of Steel in Sulphur-Containing Atmospheres at Forging Temperatures, by O. W. MURPHY, University of Michigan.

Transformation in the Carbide Phase During Graphitization, by H. A. SCHWARTZ, and C. H. JUNGE, National Malleable & Steel Castings Co.

The Hardening Transformation in Manganese Steels, by HOWARD SCOTT and J. G. HOOP, Westinghouse Electric & Mfg. Co.

Drop Forging Practices, by ADAM STEEVER, Great Lakes Forge Co.

The Cobalt-Tungsten System, by W. P. SYKES, General Electric Co.

The Temperature Atmosphere Problem in High-Speed Steel, by SAM TOUR, Lucius Pitkin Co.

The Scaling of Steel at Heat Treating Temperatures, by C. UPTHEGROVE and D. W. MURPHY, University of Michigan.

Heating Steel for Forging, by R. E. WALDRON.

Dominion Forge and Stamping Co., and N. L. Deuble, Republic Steel Corp.

Alloys of Iron, Manganese and Carbon, by Francis M. Walters, Carnegie Institute of Technology.

Creep Characteristics of Metals at Elevated Temperatures, by A. E. White and C. L. Clark, University of Michigan.

Preparation of Specimens for Deep Etching, Etching Reagents, Time and Temperature of Etching, by M. Yatsevitch, Watertown Arsenal.

A.W.S. Papers

Rolled Steel Designs for the Iron and Steel Industries, by Christian A. Wills, The William B. Pollock Co.

Precision Cutting of Heavy Metals, by Herman Ullmer, The Linde Air Products Co.

Maintenance Welding, by E. L. Quinn, Jones & Laughlin Steel Corp.

Welding of Non-Ferrous Metals in Dairy Industry, by A. T. Light, plant manager, York Ice Machinery Corp.

Welding of Duralumin, by representatives of Union Carbide & Carbon Research Laboratories.

Welding of High Nickel Alloys, by J. G. Sheoner and F. G. Flocke, International Nickel Co.

Lead Welding, by R. L. Ziegfield, Lead Industries Ass'n.

Determination of Internal Stresses in Welds by X-Rays, by John T. Norton, Mass., Institute of Technology.

Metal Deposition in Electric Arc Welding, by G. E. Doan, Lehigh University.

Corrosive Fatigue Testing, by W. E. Harvey, Lehigh University.

Tests of Welded Butt-Strap Joints, by S. C. Hollister, Purdue University.

Influence of a Magnetic Field Parallel to the Iron Arc on Welding, by F. R. Hensel and W. A. Maddox, Westinghouse Elec. & Mfg. Co.

The application of Welding to the Manufacture of Heavy Mechanical Equipment, by A. E. Gibson, Wellman Engineering Co.

Selling Welded Products, by T. C. Fetherston, The Linde Air Products Co.

Popularizing the Welded Product, by G. M. Gillen, G. M. Basford Co.

Pre-Qualification Tests of Welders, by E. Lunn, chairman, former committee on Qualification of Welders.

Discussions of Mr. Lunn's paper by H. E. Rockfeller, Linde Air Products Co., and A. Vogel, General Electric Co.

Qualification Requirements for Welders, by V. P. Marran, Walsh Holyoke Steam Boiler Works.

Load Test on a Welded Roof Truss, by C. H. Jennings, Westinghouse Elec. & Mfg. Co., Research Labs.

Properties of Metal-Arc Weld Metals, by J. C. Hodge, Babcock & Wilcox Co.

Discussion of J. C. Hodge's paper by G. R. Brophy, General Electric Co.

Metal Spraying, by H. B. Rice, Metal Spray Co.

Automobile Repair Welding, by representative of job welding shop.

Thyratron Control in Resistance Welding, by W. C. Hutchins, General Electric Co.

Application of Welding to Pressure Vessels and Metallurgy of Welds, by P. R. Hawthorne and Dr. J. C. Holmberg, Struthers Wells Co.

Welding of Pressure Vessels, by H. L. R. Whitney, The M. W. Kellogg Co.

Gas Welding of Pressure Vessels, by R. L. Shepard, Carbide & Carbon Chemical Corp.

Automatic Welding with Heavy Coated Electrodes, by L. R. Leveen, General Electric Co.

S.A.E. Production Section

What Manufacturing Equipment is Required to Meet the Automotive Designers Needs, by L. F. Maurer, Pierce-Arrow Motor Car Co., Alex Taub, Chevrolet Motor Co.

Current Applications of Cemented-Carbide Tooling, by R. D. Prosser, Thos. Prosser & Son.

Special Zinc Alloys in Die Castings, by C. R. Maxon, New Jersey Zinc Co.

Policy Announced by Committee on Allowances and Tolerances

A statement of policy to guide the work which they are about to undertake has been unanimously approved by the members of Sub-Committee No. 1 of the Sectional Committee on Allowances and Tolerances for Cylindrical Parts and Limit Gages, of which Mr. R. E. W. Harrison, of Cincinnati, is chairman.

The scope of the project with which this committee is charged is the bringing into line with present day practices, of the system of fits and tolerances tentatively approved by the American Engineering Standards Committee, now the American Standards Association, in December, 1925.

In its statement of policy the committee recognizes that experience has taught the futility of recommending a system that cannot be reasonably adhered to either economically or mechanically. It agreed therefore that the recommendations when eventually submitted shall be characterized by the extreme simplicity of their presentation. The committee further recognizes that the recommendations which it will bring forth will be put into operation by practical men and should therefore be of such a nature as to be readily endorsed by them as well as by the manufacturers of reamers and gages, and by tool supervisors, designers, production engineers and inspectors. The committee therefore concludes that while theoretical considerations cannot be ignored they must not become a part of the recommendations if they interfere with the practicability of the scheme proposed.

Grinding Wheel Standard Approved

Simplified Practice Recommendation R45-32 on grinding wheels is effective as of October 1, according to an announcement by Alexander B. Galt, acting chief, division of simplified practice, Bureau of Standards. Acceptances have been received from a sufficient number of manufacturers, distributors and users. Recommendation R89-32 covering coated abrasive products is also approved.

•BUSINESS ITEMS•

After Sept. 7, the E. L. Essley Machinery Co. of Chicago will occupy new offices in its showroom and warehouse building at 825-845 Kees St. This move follows the trend of breaking away from the congested downtown district, and will provide the company with better facilities.

The Chicago office of the Cincinnati Milling Machine Co. and Cincinnati Grinders Incorporated is now located at 2400 W. Madison St.

The recently incorporated Illinois Gear & Machine Co. is now operating the Ganschow division plant of Gears & Forgings, Inc., 2108 N. Natchez Ave., Chicago. V. P. Reilly, formerly with the Foote Bros. Gear & Machine Works, Chicago, is president.

Babcock & Wilcox, Inc., will open a new wing at its Barberton, Ohio, plant about Oct. 1, according to an announcement by I. L. Langvand, assistant superintendent. The new unit, which is 100 by 300 ft., will house machinery that will supplant the production of the company's Bayonne, N. J. plant, now being dismantled.

The Fred F. French Bldg., 551 Fifth Ave., New York, N. Y., has established a Service Division on the third floor, which includes a Small Office Plan. This plan offers out-of-town firms the opportunity of securing a small office, or desk room with telephone and mail service. There is also a plan which gives a mail address, and takes care of and forwards mail and telegrams, and handles telephone calls at minimum cost.

Benjamin Stewart & Sons, Inc., Hamden, Conn., has incorporated to conduct a foundry with a capital of $50,000. The incorporators are: Benjamin Stewart, D. C. Stewart and E. C. Gronberg, all of Bridgeport.

Articles of incorporation have been filed in Indiana by the Excel Mfg. Corp., Muncie, formed to manufacture all kinds of metal products, automobile parts and accessories. The first board of directors is composed of James H. Reichart and Thomas G. O'Mara.

Reconstruction & Research Corp. has been organized at Columbus, Ohio, by Samuel P. Bush, former president of Buckeye Steel Castings Co. The company will render industrial, business and investment counsel, and has arranged for affiliation with Beman Thomas & Co., accountants and engineers, of Columbus. Mr. Bush will be president and managing director; Beman Thomas, first vice-president; James S. Bush, of Dayton, second vice-president, and George G. Thomas, secretary and treasurer.

The Charles Parker Co., Meriden, Conn., has absorbed the Artistic Bronze Co., Bridgeport, and the business of the latter company will be moved to Meriden. The acquisition will broaden the production of hardware specialties by the Charles Parker Co. William

WRIGHT, president of the Artistic Bronze Co., becomes vice-president of the Charles Parker Co.

Hobart Bros. Co., Troy, Ohio, manufacturer of arc welders and welding equipment, has appointed DORSEY C. ANDERSON as Central Atlantic distributor with headquarters at 857-C Terminal Commerce Bldg., 401 N. Broad St., Philadelphia. A service organization is being built up and a stock of welding rods and equipment will be carried.

Machinery and equipment of the Hercules Mfg. Co., Inc., Indianapolis, Ind., has been purchased by MARION G. STALEY, formerly of South Bend. Plans are being made to move the plant to a new location and to resume operations. The company manufactures magnetos for stationary and marine engines.

Plant, machinery and tools, and material of the American Forge & Machine Co., 1635 Barth Ct., S.W., Canton, Ohio, will be sold at public auction Sept. 15, at 10:30 A.M., on the premises.

The Sessions Foundry Co., Bristol, Conn., has closed down indefinitely, according to JOSEPH B. SESSIONS, president.

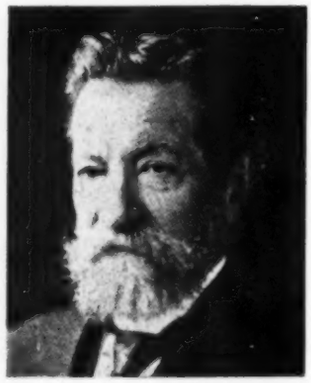
• OBITUARIES •

JAMES M. WAKEMAN, who will be well remembered by those familiar with the technical publications of about 30 years ago, died on Aug. 24. Born in Wolverhampton, England, in 1865, he came to this country in 1886. His first connection with journalism was as Western Manager for *Locomotive Engineering* and the *American Machinist* with headquarters in Cleveland. Later he was president of the *Engineering & Mining Journal*. He became vice-president and general manager of the McGraw Publishing Co. in 1899, continuing until 1910, giving special attention to the *Electrical World and Engineer*. He was a director of the American Trade Press Association and its president in 1902-1903. He next became manager of the Society for Electrical Development, retiring in 1921. He was a member of many electrical associations, was vice-president of the Municipal Art League of Orange, N. J., and a member of the Engineers' Club of New York. He is survived by his widow, Jessie Smieton Wakeman, of East Orange, N. J.

ERNEST C. PROBST, 55, formerly chief engineer of the Dahlstrom Metallic Door Co., and for many years identified with the engineering division of the Art Metal Construction Co., Jamestown, N. Y., died at his home in LaPorte, Ind., following a brief illness.

Pioneer Gear Manufacturer Dies

HUGO BILGRAM, president of the Bilgram Gear & Machine Works, Philadelphia, died on Aug. 27. In 1883, Mr. Bilgram built the first bevel-gear generator which has since revolutionized the art of cutting bevel gears. Before this, he had been identified for many years in the metal-working trade as machinist, foreman and designer. He was born in Bavaria in 1847 and, in 1863 he entered the Polytechnic School of Augsburg and graduated in 1865 from the course of mechanical engineering. After working as a draftsman and machinist in Germany, he emigrated to the United



States in 1869 and settled in Philadelphia. Here Mr. Bilgram worked for several concerns, including the Southwark Foundry and with Brehmer Bros. When this company transferred its works to Germany, he was put in charge of the branch in this country and later became sole owner. In 1909, the works was incorporated as The Bilgram Machine Works.

In 1876, Mr. Bilgram was assistant to Professor Louis M. Haupt, who conducted an evening class in drawing at Franklin Institute. In an effort to facilitate the drawing of accurate outlines of teeth of gear wheels, he discovered that by a modification, which was elaborated and described as "A New Odontograph," the use of the diagram was facilitated. Later he realized that the same method could be incorporated in a machine for cutting the teeth of gear wheels, particularly of bevel wheels, and it thus came about that the first machine was designed in 1883. His attention was then turned to the development of cigarette machines which caused him to permit the patent on the bevel gear machine to expire. A competitor then obtained a patent on an improvement that adapted the machine to production work, particularly in the automobile industry.

• PERSONALS •

LOUIS E. UNDERWOOD, managing engineer of the stationary motor engineering department, General Electric Co., Lynn, Mass., has been appointed manager of the Pittsfield, Mass., works to succeed E. A. WAGNER, retired. Mr. Underwood joined the General Electric organization in 1897, and was made chief engineer of the stationary motor engineering department in 1915, and managing engineer of the consolidated motor department in 1927, in charge of manufacturing and engineering.

W. W. BRIERLY has resigned as president and general manager of the Millbury Steel Foundry Co., Millbury, Mass., to become associated with the Malleable Iron Fittings Co., Brantford, Conn., as district manager of the steel c 'ings division.

W. G. HUME has been appointed general manager of the Superior Steel & Wire Co., Knightstown, Ind., and succeeds S. S. SHAMBAUGH. Mr. Hume was formerly vice-president of the Northwestern Barb Wire Co.

WEBSTER N. JONES, general superintendent of the processing division, The B. F. Goodrich Co., Akron, resigned that position August 1 to become director of engineering at the Carnegie Institute of Technology, Pittsburgh. He returns to the educational field, having spent ten years in teaching at several universities.

MALCOLM W. REED has been appointed chief engineer of the American Steel & Wire Co., with headquarters in Cleveland. Mr. Reed succeeds B. H. LAWRENCE, who has been transferred to New York.

• MEETINGS •

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. National Machine Shop Practice Meeting, Buffalo. Week of Oct. 3. Calvin W. Rice, secretary, 29 W. 39th St., New York, N. Y.

NATIONAL METAL CONGRESS & EXPOSITION. 174th Regiment Armory, Buffalo, N. Y., Oct. 3-7. Sponsored By A.S.S.T., with cooporation of A.S.M.E., Institute of Metals and Iron & Steel Divisions of A.I.M.E., A.W.S., S.A.E., and the Wire Association. W. H. Eisenmann, 7016 Euclid Ave., Cleveland, Director.

NATIONAL SAFETY COUNCIL. Twenty-first annual safety congress, Washington, D. C., Oct. 3-7. National Safety Council, Civic Opera Bldg., 20 North Wacker Drive, Chicago.

Shall the Customer Furnish Gages?

Al entered the restaurant where he and his friend Ed met every other Wednesday, and found Ed eating his lunch. "Sorry I kept you waiting, Ed," he said.

"You didn't keep me waiting, big boy; I don't let anyone keep me away from the table. What was the matter, more trouble?"

"No, just delayed a little too long in starting. That's all."

"By the way, Al, what did you find wrong with that compressor you had trouble with last week? Or didn't you find it?"

"Sure, we found it. We sent the casing down to old man Tucker's shop, you know. Well, when he bored one side, and then turned it over, there must have been a chip on one of the chuck jaws or else one of them was loose and cocked when it was tightened. Anyway, the two ends of the cylinder were not parallel. The rotor was parallel, and this meant that one of the end plates did not make contact all around the cylinder. The oil kept it sealed fairly well when the compressor was first started but when the oil warmed up the pressure would blow back from the casing into the cylinder at about thirty pounds and we were only pumping the same air round and round. We had Tucker straighten up the casing, and we shortened up the rotor and took a light cut off the outside to restore the capacity, and everything went O.K. We got an order for four more."

"What did old man Tucker have to say? You know, he's always boasting about what good work he does."

"Yes, I know he is. He was mad, not at himself, but at us. He said he ought not to have taken the work because there were no gages. Told us not to send any more unless we sent gages with it."

"Well, that's not such a bad idea. Going to do it?"

"I don't know. Mason and I are debating it. He sees no objection to doing it, but I claim our allowances are so liberal that gages should not be necessary."

"Kind'a changing your tune, ain't you?"

"No. Not at all. Our product is just a little different, that's all."

"Man, what a difference there is between a manufacturer and a mere foreman. I've heard you argue time and again for definite tolerances from customers, and say that they ought to furnish gages if they wanted interchangeable parts. If I've heard you say it once I have a hundred times, that the man who claimed his product was different had no right to hold the position he occupied. Now you're taking the opposite side of every question."

"Maybe I'm getting a little broader view of things, Ed, and have found that there are really exceptions to every rule. I don't make such definite statements as I used to. But about the gages. We're not fussy about the diameter of the cylinder, and it can be any length as long as the ends are cleaned up. It is important that the length of the cylinder and rotor be exactly the same, and we turn and face the rotor to match the cylinder. Gaging one of them don't help. That was just old man Tucker's squeal because his tail was pinched."

"Maybe, but it strikes me as a pretty good idea anyway, and I'm going to see if I can't get Williams to start that same practice. I'll buy old man Tucker a drink next time I meet him."

Is Tucker right about demanding gages, or was it merely an evasion of responsibility?

Discussion

Divided Responsibility

It is probably the best bet for Al to let the whole job of building his compressor out and to hold the jobbing firm responsible. But if the troubles arise from engineering faults, the jobber could not be held responsible.

Al and Mason have decided to let their work out and do the engineering in their own shop. It stands to reason that they know the jobbing shop and the equipment that is used for the manufacture of their parts; if not, they should look the place over. Only good equipment can produce good work at reasonable cost, and by making sure of this, a lot of trouble can be avoided.

When letting out parts, complete specifications should be given to the jobbers, and particular attention should be paid to parts that are delicate and important. Before accepting any finished work, it should be carefully inspected. It is important to watch the jobber's method of doing the work so that one can judge whether a job is bound to come out right or wrong. As a rule, the jobber is careful to get good results to hold his reputation; otherwise he may lose a customer.

—A. Beusch.

There is no reason why divided responsibility is not workable in manufacture as elsewhere. A people with a tradition for democracy resent the domination of a dictator, either in government or in business. As a result, a system of management has grown up that depends on cooperation and exchange of ideas.

Of course, this is at variance with the so-called rugged individualism of the

past, but in the complex civilization in which we live, few individuals are self-sufficient. The cause of many of our troubles is not divided responsibility but evasion of responsibility. The sharing of a job by two or more persons is no reason for neglect on the part of any of those affected.

—Walter Ransome.

Divided responsibility never works. When a man is given a definite job to do, he will take a pride in doing it properly and will be prepared to stand back of the results. But if he shares the credit or the blame with another, his interest and his effort slackens. If anything goes wrong, buck passing is the consequence.

However, divided responsibility should not be confused with division of labor,

either in the shop or in management. Taking the example given, Tucker was given a casting to machine. His job was to finish the work according to specification, while Al's job was to assemble the complete unit. Strictly speaking, there is no division of authority in such an arrangement. There is only the uncertainty of placing the blame for the trouble because of ignorance as to its cause.

—Thomas O. Ford.

Divided responsibility is not a thing to be entirely shunned, though it is the direct cause of trouble at many points. It is a necessary evil in this age of specialists, whose highly concentrated labors are undoubtedly responsible for a great deal of our progress. Even where the entire product is machined in one shop, there is an inevitable division of responsibility. In any sizable factory, this first falls to various of the departmental foremen, and they, in turn, subdivide it among their operators. No man is so likely to make a clown of himself as the one who attempts to supervise everything.

Al is in trouble temporarily at least, and Ed speaks reminiscently of headaches. Most products, which really amount to anything, have been evolved through and actually developed because of troubles experienced. When Al and Mason find their trouble, they will know their "rotary" a little better than they do now, and will be able to avoid the same trouble in the future. But it may be only the initial one of a string of eight or ten.

—Joe Hendricks.

How Much Economics?

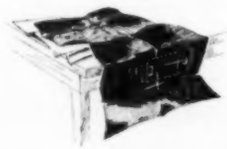
One can safely assert that foremen and office staff know little of this subject. One or two in any office is about the limit. Secretaries, accountants, directors, and proprietors even, do not always include it in their studies, depending rather on their business instinct. Therefore, one feels bound to assert that the above subject is not essential to good foremanship. If those who should have devoted themselves to it have neglected their duty, that is no reason why foremen should tackle the subject. They are essentially practical and technical men, whose chief duty is to supervise production. To thrust the science of economics upon them will tend to distract them from legitimate duties, thus rendering them less efficient.

—William Bryce,
Sheffield, England.

Cutting Loose

After Al cuts loose from his present job he has a perfect right to expect work, either experimental, tool or manufacturing, from his former employer. Were he discharged for incompetency, he would have no right to expect the work, but since his conduct and management have been satisfactory to Williams to the last, he should be given preference on jobs sent out. He is familiar with the requirements, equipment and personnel of his client and should be able to give as good a product as anyone.

Al sure used his head when he would not invite Williams into his company. I have observed that a person working for one company and having money in an-



other will be criticized for things he does, even though they are perfectly fair. Scandal is easily started and grows rapidly. So for the good of both Williams and Al, there should be no financial connection between them.

—F. F. Anderson.

Old Man Opportunity

Unless the extending of opportunities to learn higher-paying jobs can be made strictly selective, this practice is unwise. There are too many men with "grasshopper" minds, jumping from one thing to another; today they would be a toolmaker, tomorrow a patternmaker, and on the day after they will be equally certain they are better qualified to become a draftsman. But these same men will feel sincerely hurt if the foreman appears to discriminate against them by selecting others for what may appear to be special favors.

—Herbert C. Wadsworth.

In Our Own Shop or Outside?

In placing a new product on the market, there are two distinct problems of manufacture: design and production. Unless one has a big staff available, these problems are best handled separately. Until the design is put on a commercial basis, it is wise to leave the manufacture to someone else.

There are shops which specialize in doing small lot or experimental work. Especially today they will quote a lower figure on such jobs than can possibly be reached by equipping a plant even on a modest basis.

The practical man is prone to forget principles underlying the financial side of his business. Before he realizes it, he has built up an overhead that gobbles up the profits.

My suggestion to Al would be to hold off equipping his own shop until he sees a steady flow of work and a design free from bugs. Otherwise he will have a hard struggle to justify his purchases of equipment.

—E. A. Webber.

When this question confronts a new firm, a suitable solution may be found only by a careful survey of existing orders and potential market for the product to be manufactured. Any man, who thinks a new business is a sort of snap that will in a measure care for itself, is already halfway into trouble. I should and would make a careful estimate of the probable business over a given period and divide it by three or four for safety. Then, against this third or fourth, I should charge interest, overhead, rent and depreciation for the same period of time. If the business did not give excellent promise of covering these charges, I would be satisfied with Al's garage for a season, and let someone else do the manufacturing. This would also give me a better chance to do some extra pushing along the sales line.

Then, of course, there is a middle path which may be the best of the possible three. Al might buy some of his parts out, as so many are doing today, and only do a small part of his own machining, and possibly all of the assembling. It cannot be denied that this is the day of the specialist, so he will be likely to find there are some parts of that compressor-pump that he will be able to buy for less than he can make them.

—John E. Hyler.

American Machinist
Reference Book Sheet

Electroplating Aluminum

ALUMINUM has been considered a difficult metal to plate, but actually it is as easy to plate on as other metals if simple precautions are followed. Care should be exercised: first, in selecting the type of deposit best suited to the particular job; second, in cleaning; and, third, in considering the composition of the alloy being plated on. For dry indoor service it is possible to apply a flash coating of zinc or chromium to aluminum and then to plate with nickel, copper, or other metals. Where moisture is present, it is preferable to apply a preliminary nickel coating after a carefully regulated surface roughening. Then the desired metal can be applied over the nickel.

Since cleaning of aluminum is somewhat different from the cleaning of other metals, reference should be made to the Reference Book Sheet "Cleaning Aluminum" (*AM*—Vol. 76, p. 973).

Smooth Surface Plating

Chromium can be applied directly to aluminum from an ordinary chromium bath at about twice the usual current density used for plating over nickel, after cleaning by a short dip in alkaline cleaner. With certain of the casting alloys, an additional dip in nitric and sulphuric acids or nitric and hydrofluoric acids is required to whiten the surface. When plated from a hot solution (118 deg. F.), the chromium is lighter in color than when plated from a cold solution (80 deg. F.), but the deposit from the cold solution is much more readily polished to a high luster.

Zinc can also be plated directly on a smooth surface of aluminum, the metal being cleaned, rinsed and dipped for 60 seconds in acid cleaner. A satisfactory zinc-plating bath is as follows:

Zinc cyanide Zn $(CN)_2$	4 oz./gal.
Sodium cyanide (NaCN)	4 oz./gal.
Ammonium hydroxide (NH_4OH) (Sp.g.0.90)	4 oz./gal.
Peptone	⅛ oz./gal.

This solution is used at a current from 1 to 5 amp. per sq.ft. for from 1 to 10 min. The plating is quite resistant to corrosion where zinc alone is the metal coating, but when other metals are subsequently plated, the product does not resist corrosion well.

Plating on a Roughened Surface

For general use, nickel should be the first metal applied to aluminum, and this plating should follow a surface roughening. It is not sufficient merely to produce an irregular surface such as might be obtained by sand blasting. The surface should have irregularities and pits that have a special undercut shape, so that the coating will be anchored to the surface. This condition is produced with special etching reagents. The reagent dissolves out certain portions of the surface selectively, and the number, character and placing of these openings is greatly affected by the composition of the metal or alloy. It is in this roughening that the plating of aluminum differs markedly from the plating of other metals.

2S Aluminum

The most satisfactory etching solution for roughening commercially pure aluminum has the following composition:

Nickel chloride ($NiCl_2 6H_2O$)	36 ozs.
Hydrochloric acid (HCl) (Sp.g.1.18)	0.2 gal.
Water	1.0 gal
Temperature	90 deg. F.

The time of dip must be carefully determined by experiment. When the dip is functioning properly, the aluminum should come from the solution with a glossy gray nickel immersion layer resembling a nickel plate. Under the above conditions the time of dip should be 15 seconds, but this will vary somewhat.

In the use of this dip the two most important factors to control are the temperature and the acidity. Even slight changes in the temperature cause a considerable change in the best dipping time. Where a dip is being used continually, replacements of the hydrochloric acid, consumed in etching the aluminum, are necessary every hour. A slight increase in acidity is needed to avoid a reduction in the speed of etching. When the dip is new, it sometimes does not function properly. Hanging pieces of aluminum in the dip tends to work out the copper and other impurities, and sometimes it is advisable to add aluminum chloride to make the new dip operate smoothly. The gage of the metal being dipped is also a factor that affects the best time of dipping. Thin gage sheet is etched more rapidly than heavy gage sheet. Hard-rolled sheet generally presents greater difficulties in etching than soft metal. For very hard sheet, it is often necessary to use the procedure advised for 3S.

3S and Strong Alloys

The roughening of the alloys in this group is best accomplished in the following dip:

Hydrochloric acid (HCl) (Sp.g.1.18)	1/3 gal.
Water	2/3 gal.
Manganous sulphate ($MnSO_4 2H_2O$)	½ oz.
Temperature	90 deg. F.

The time of dip in the above solution varies with the alloy composition and heat-treatment. Usually about 15 or 30 seconds proves sufficient for commercial work. Occasionally, metal will come from this dip

Courtesy of the Aluminum Company of America

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Reference Book Sheet

Electroplating Aluminum

with a dark film on the surface caused by the alloying constituents. This can be brushed off or removed by a dip in concentrated nitric acid or a nitric and sulphuric acid mixture.

The group of strong alloys presents several peculiarities. In the first place, the heat-treated alloys give a plated product that is more resistant to corrosion than the corresponding untreated metal. There are also differences among the alloys. 51S is the most readily plated. 17ST is readily plated as screw machine products, but often gives trouble in sheet form due to metal streaks. 25S may also give trouble in sheet form.

With some of the alloys in this group, particularly in the annealed state, the nickel dip may be used.

Castings

For the roughening of castings the following dip is advised:

Nitric acid (HNO_3) (Sp.g. 1.42) ..... 3 parts
Hydrofluoric acid (HF) (48-52 per cent) ..... 1 part
Temperature ..... 75-80 deg. F.

There is a fairly wide range in the time allowable for dipping. Usually the proper time lies between 15 and 30 seconds for die-castings and 60 to 120 seconds for sand castings. The effect of temperature on the action of the dip is not great. The container for the dip should be lead lined. It should also be painted with a mixture of one part of beeswax to four parts of paraffin.

Alloy No. 195 presents special difficulties. Even a 5-min. etch is not sufficient to secure adhesion, although the corrosion resistance of the plate appears fairly good. The procedure for the strong alloys may be applied to secure good adhesion, but it is sometimes difficult to obtain uniform results. Generally a 2- or 3-min. etch in the above solution is advised.

Nickel Plating

Two nickel baths that have proved satisfactory are given below:

Nickel sulphate ($NiSO_4 7H_2O$) 19 oz./gal.
Magnesium sulphate ($MgSO_4 7H_2O$) 10 oz./gal.
Ammonium chloride (NH_4Cl) 2 oz./gal.
Boric acid (H_3BO_3) ..... 2 oz./gal.
Temperature ..... 90-95 deg. F.

or

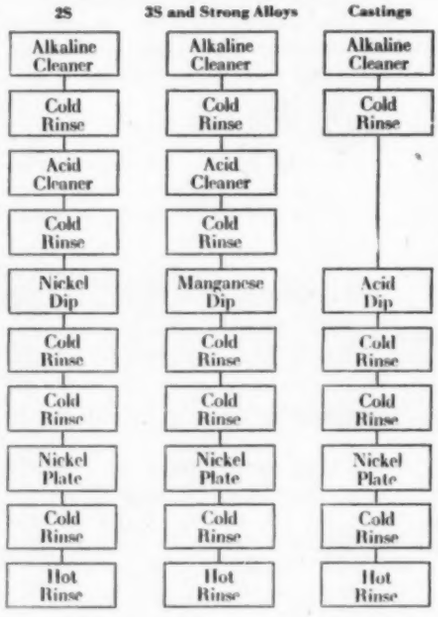
Nickel sulphate ($NiSO_4 7H_2O$) 16 oz./gal.
Sodium sulphate (anhyd) (Na_2SO_4) 26 oz./gal.
Ammonium chloride (NH_4Cl) 2 oz./gal.
Boric acid (H_3BO_3) ..... 2 oz./gal.
Temperature ..... 90-95 deg. F.

A current density of 15 amp. per sq.ft. is advised for both solutions, although under special conditions changes may be needed. A pH value of 5.8 to 6.0 (colorimetric) gives good results.

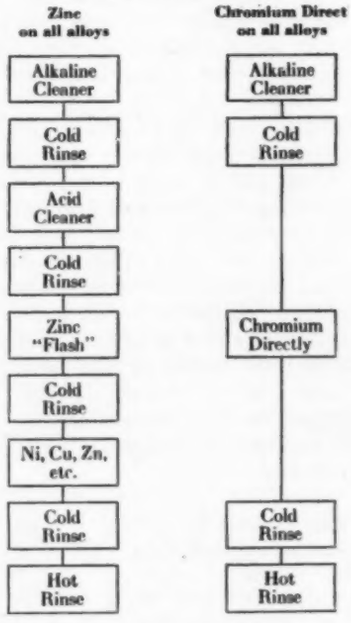
Both of these solutions have a tendency for hydrogen pitting, and in applying heavy deposits it is advisable, generally, to make frequent additions of hydrogen peroxide or sodium perborate. The bath containing the magnesium sulphate gives a deposit that seems to buff more readily, but the latter bath has the better throwing power. The nickel deposit obtained from this bath should be a smooth, glossy gray. It will polish to a high luster as readily as nickel from a hot solution on steel. For a deposit on aluminum that must stand moderate outdoor service, a thickness of at least 0.0005 in. to 0.001 in. is recommended.

The nickel deposit may serve as the foundation for a variety of other plates. Chromium may be applied readily over the nickel from the ordinary chromium baths now being used commercially. A deposit of about ½ min. is advisable. Copper may also be applied over the nickel from either a cyanide or an acid bath. Brass may be applied to the nickel, but particularly good nickel plating is required.

PLATING DIAGRAMS FOR PLATING ROUGHENED SURFACES



PLATING DIAGRAMS FOR PLATING SMOOTH SURFACES



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Machinability of Rustless Steel

ALTHOUGH laboratory tests had given such favorable evidence on the efficacy of selenium as a free-machining agent, it remained for commercial machining operations to deliver the final proofs.

This proof was sought on an extensive scale, and machining reports were submitted by more than one hundred different shops, involving a wide variety of machine operations. A cross section of these many reports amply confirms the value of selenium as a free-machining agent, and the average would probably put the machinability of 18-8 rustless containing selenium at about 70 per cent of cold-rolled screw stock. It should be borne in mind, however, that rustless steel will average, well over 100,000 pounds per square inch tensile strength, which is far beyond the range of cold-rolled steel; this in itself may account for some of the difference in machinability.

A typical test is given herewith in detail. This is particularly interesting because it furnishes a direct comparison between the regular 18-8 rustless and the new 18-8 containing selenium.

Test Results

Operation: machining 5/8x3-in. cap screws. U. S. threads.

Machine tool: Cleveland automatic, Model A—1¼-in.

Steel Tested: Cold-drawn 1-in. hexagon bars analyzing:

Identification	C	Cr	Ni	Se	Brinell
No. 4	0.08	18.35	8.78	....	255
No. 8	0.09	18.18	9.21	0.21	255

Tools: Box, cut off, and champfering tools—high-speed tool bits. Modern Tool Company self-opening die head—H. S. chasers.

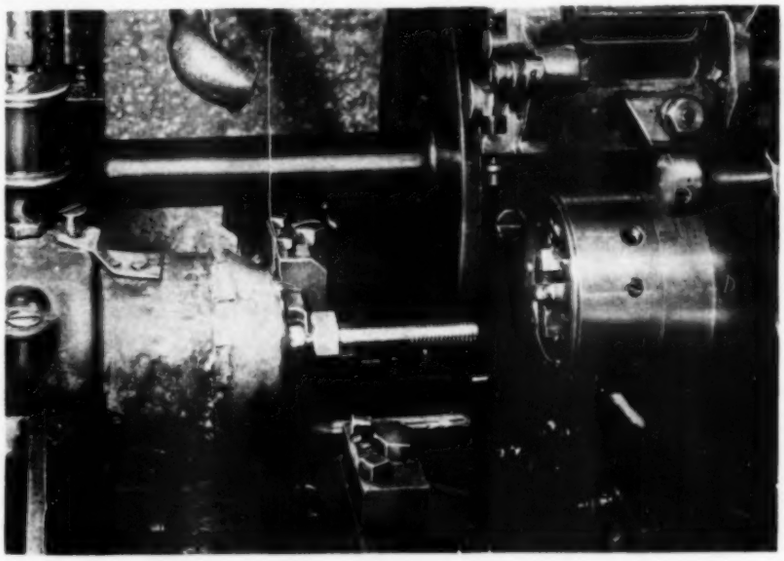
Lubricant: 20 per cent lard oil—80 per cent parafine oil.

Cutting Data

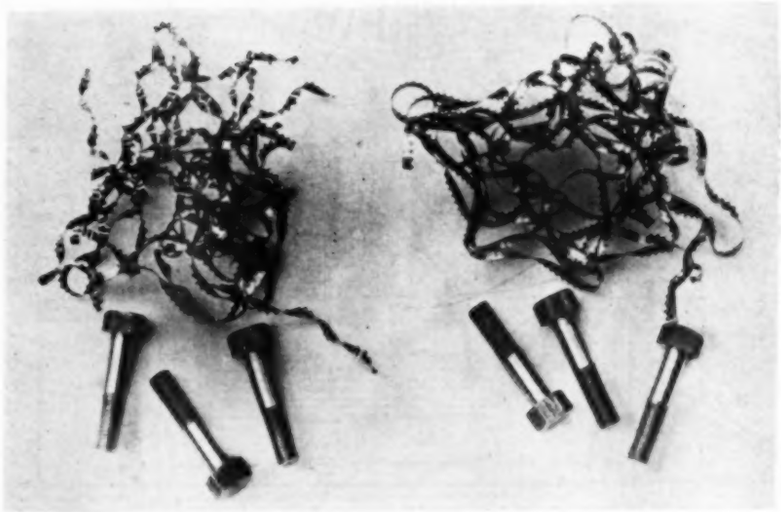
Identification	Surface Speed—Turning Ft. per Min.	Surface Speed—Threading Ft. per Min.	Box Tool Feed In. per Rev.
No. 4	61	7	0.003
No. 8	103	24	0.003

The above figures, while convincing enough, hardly measure the entire difference between the two steels. The chips from the standard 18-8 steel were so tough that they could be bent flat upon themselves without breaking. Several times the tools had to be cleared of chips by using a pair of tinner's shears. The selenium 18-8 chips had the same general form as the other but were brittle enough to break up of themselves in 6 to 12-in. lengths and so keep clear of the tools.

The attached photograph shows screws and also box-tool chips produced on each steel. The difference in length of chips is clearly shown by the photograph.



Rustless steel cap screws were threaded to determine the effect of selenium on machinability



Chips on the left are from a steel containing selenium, those on the right are from regular 18-8 rustless steel

• IDEAS FROM PRACTICAL MEN

Magazine and Dial for Automatic Milling

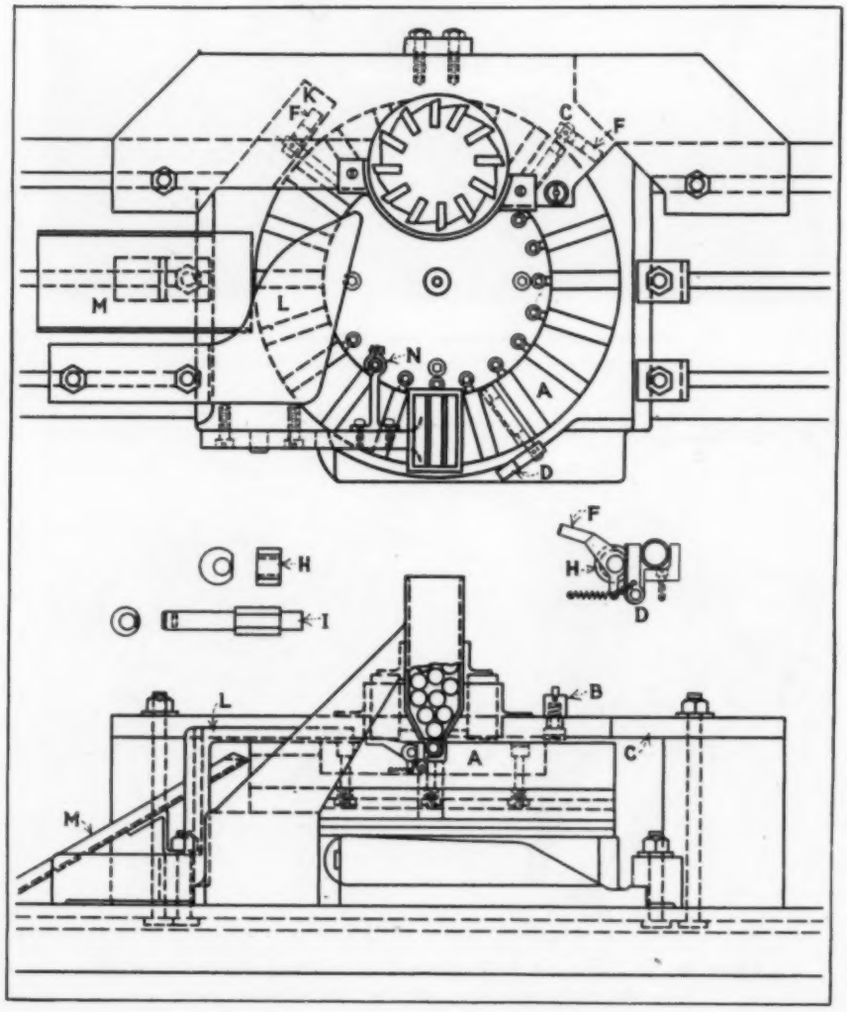
WM. C. BETZ
Master Mechanic, Fafnir Bearing Company

In the illustration is shown a fixture for milling the bases of small spirit levels, both round and hexagon. All work pertaining to loading, clamping, feeding and ejecting is done automatically. All the operator has to do is to keep the magazine filled and to see that the pieces are dropping from it into the stations.

In operation, the pieces drop by gravity from the magazine into the stations in the dial *A*, which is mounted on the power-driven rotary table of a vertical milling machine. The dial has twenty stations and rotates counter clockwise, making one revolution in two minutes. As a loaded station passes the spring-actuated plunger *B*, the work passing beneath the plunger is forced to its seat. Clamping is done by a cam-actuated clamp at each station. On further rotation of the dial, the cam levers are depressed by passing under the plate *C*, rotating the cams and clamping the work. Details of the clamping mechanism are shown at *D*, in which *F* is the cam lever and *H* one of the cams, while *I* is the shaft on which the cams are mounted. Milling is done by a 6-in. cutter having inserted blades of Stellite and running at 230 revolutions per minute.

After each piece has been milled, pressure on the cam lever is automatically released by passing under the pocket *K* in the underside of the plate *C*. A spring rotates the cam and releases the work. As the dial rotates it brings the inner ends of the work into contact with the ejecting cam-plate *L*. The work is then gradually pushed out of the stations and into the inclined chute *M*, from which it is delivered to the machine table and falls into a tote box. Just before each empty station reaches the magazine, a blast of compressed air from a nozzle held in the bracket *N* enters a hole at the rear end of the station and blows out all chips and refuse, leaving the station clean for loading.

Since there are twenty stations in the dial and the dial makes one revolution in two minutes, the possible production is ten pieces per min. or 600 pieces per hr. However, as allowance must be made for unavoidable lost time, the net production is about 500 pieces per hr. Two machines equipped with such fixtures as the one described are operated by one girl, giving a total output of about 1,000 pieces per hour.



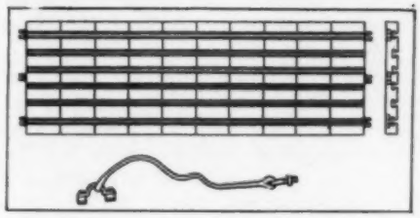
Saving Time in Planer Work
Discussion

JAMES C. HARPER
Oakshaw, Paisley, Scotland

In an article under the title given above (*AM*—Vol. 76, page 564), D. Q. Dunstone points out that if an additional table is provided for each planer and the operator sets up new work upon it while his machine is running, much of his idle time can be utilized.

That there is considerable merit in his suggestion is not to be disputed. However, objection may be taken to the scheme on account of the great increase in floor space required at the front and rear of the machines. Also that the opportunity for setting up new work is conditional upon the operator having the necessary time at his disposal. Since a large proportion of planer work requires the constant attention of the operator, he will have very little time for setting up new work. Consequently, the machine must remain idle during the greater part of the setting up time.

With a view to higher efficiency, the following method has been adopted in some shops that I know of: Instead of being designed to reduce the idle time of the operators, primary consideration has been given to reducing the idle time of the machines. Obviously, however, the idle time of the machines can not be reduced if the operators are required to set up new work. This being so, the responsibility for setting up new work has been assigned to one man who devotes his whole time to the job, and who, by his experience and skill, is able to get the best results. Since the operators do not set up the work, it is not necessary to have it done in close proximity to the machines, so that the arrangement of pedestals and rollers at each end of the machines, as suggested by Mr. Dunstone, is neither desirable



nor necessary, and the floor space around the machines can thus be conserved.

Instead of having an additional table for each machine, a number of auxiliary tables, as shown, have been provided. The work is set up on the auxiliary tables and they are mounted on the regular tables of the machines. A space where all setting up is done has been allotted near where the castings come into the shop, and where the work is done while the auxiliary tables are supported on trestles. The tables are handled by crane, using special slings as shown below the table, the eyes being attached to the auxiliary tables by T-bolts. Completed work is not removed from the auxiliary tables until after it has been inspected.

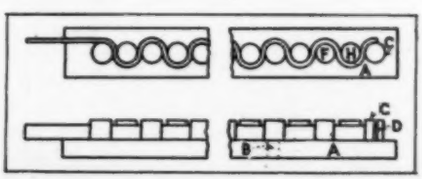
Ten such auxiliary tables are sufficient for serving a battery of six planers. Their cost is considerably less than would be required to equip six machines with duplicate tables. One skilled worker can get up enough work to supply six to eight planers. Seven minutes is a fair average time for changing a table to and from the machine.

A Corrugating Fixture

JOHN E. HYLER

In the illustration is shown a fixture that is very covenient for corrugating light bars. The block *A* is drilled at at regular intervals to receive a series of shouldered pins, one of which is indicated at *B*. All the pins except the first one at *C* are a push fit in the holes provided for them. The pin *C* is permanently secured to the block by welding and has a slot at *D* to hold the end of the bar while the corrugating is being done.

In operation, with all of the removable pins removed, one end of the bar to be corrugated is placed in the slot *D* and is swung part way around the pin *C*. Then pin *H* is pushed in place and the bar is swung part way around it in the reverse direction. Then pin *F* is put in place and the operation is continued until the bar has been entirely corrugated. While the fixture is very simple, its principle is applicable to a number of variations. For instance, the pins may vary in size, growing progressively larger or smaller, or alternating in size. Again, the pins may be arranged on a contour line of any shape, circular, elliptical or what you will.



Universal Curling Fixture for Flat Stock

EMIL WITTMANN

In the illustration is shown a fixture for curling strips of flat stock to various diameters, as indicated in the upper left-hand corner. The rib *A* is welded to the bar *B*, as shown in the section *Y-Y* at the right, and provides a means for holding the fixture in the vise. Plate cam *C*, pivoted at *D* and operated by lever *F*, acts against the surface of the sliding member *H*, which imparts motion to the forming block *I*. The forming block is reversible and has four semicircular grooves for making curls of different diameters. Each of the grooves is easily brought into working position by either rotating the block 180 deg., or by turning it upside down.

The work is located endwise by the adjustable stop *K*. Near the end to be curled, the work is held down by the clamp *L*, shown in detail in section *X-X* at the left. The clamp is slid on or off the work sidewise and is provided with the latch *M* to prevent it from springing under pressure of the clamping screw.

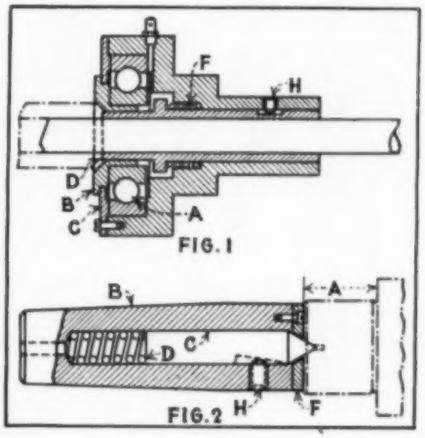
In operation, when the cam is rotated and the forming block contacts with the work, the curl is formed by the metal being rolled up in the semicircular groove at the bottom. Heavy stock is heated for curling. A coil spring keeps the sliding member in contact with the cam at all times.

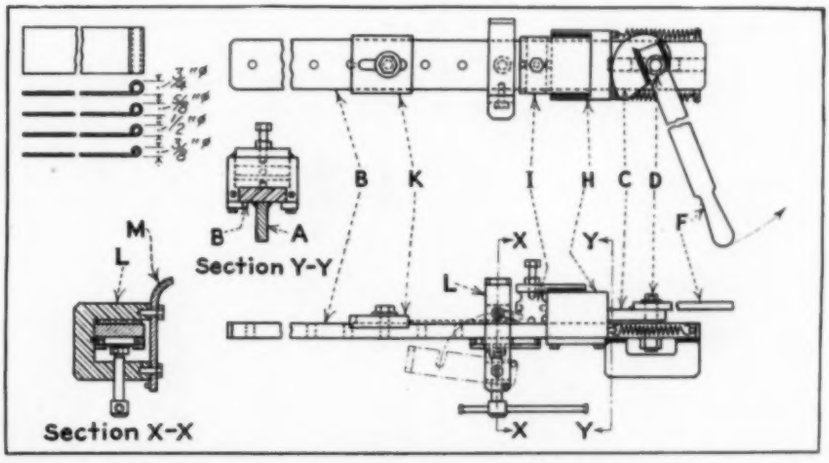
Special Centers

D. L. BROWN

In drilling bars with a Pratt & Whitney gun drill, we felt that the work should be better supported and the drill better guided than by the usual appliances, so we designed the drill guide and the ball-bearing cup center illustrated in Fig. 1. The radial thrust bearing *A* is mounted in the body of the fixture. The hardened centering cup *B* is ground to a press fit in the ball bearing, the retaining plate *C* keeping the grease in and the dirt out. The sleeve *D* is a sliding fit in the body of the fixture and on the drill. It is pressed forward by the spring *F* and is prevented from turning by the setscrew *H*. As the sleeve is pressed tightly against the end of the work, there is no chance for the chips to clog the drill and break it. The design provides a ball-bearing cup center that revolves with the work and a guide bushing for the drill of unusual length, in addition to a practical method of keeping the body of the drill clear of chips.

In Fig. 2 is illustrated a spring center for the headstock which is used on a multiple-tool Le Blond job where it is





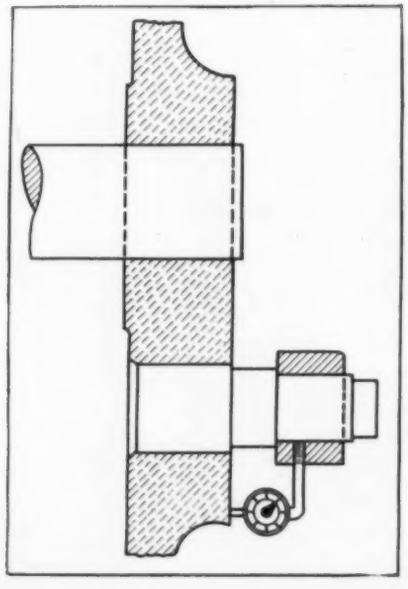
necessary to duplicate the dimension *A* in any number of pieces of work, regardless of variations in the depth of the countersunk centers. The sleeve *B* is a taper fit in the spindle and the hole is ground for a sliding fit for the spring-actuated center *C*. With the work mounted on the centers, the tailstock center is brought forward, bringing the work into contact with the hardened plate *F*. A setscrew at *H* locks the center and prevents it from moving either from vibration or the pressure of the cut. It will thus be seen that the dimension *A* in any number of pieces of duplicate work will bear the same relation to any fixed part of the machine, irrespective of the depth of the countersunk centers.

Checking Locomotive Crankpins—*Discussion*

J. T. TOWLSON
London, England

Neither of the methods of checking crankpin alignment shown by Frank C. Hudson (*AM*—Vol. 76, page 244) seems entirely satisfactory. The first requires leveling of the axle and pins, and the second, in addition to using the old caliper, makes no provision for measuring at equal distances from each side of the pin.

I would suggest using a collar with a dial gage attached as shown herewith. The collar is a good fit on the pin and must be kept tight against the shoulder of the pin. By turning the collar on the pin, the indicator shows any variation in alignment, providing of course that there is a true surface around the pin hole in the wheel against which it contacts.



Milling Fixture for Resurfacing Roll Centers

A. W. DILTS

While master mechanic of a plant engaged in pulverizing material for the manufacture of cement, I had to recondition the rolls of the pulverizers about once in every six months.

The rolls consisted of chilled plates *A* bolted and keyed to cast-steel centers *B*, which were in turn keyed on shafts 18 in. in diameter. The cast-steel centers were octagon in shape and had lengthwise keys tightly fitted in the center of the faces. When fully assembled, the rolls were 36 in. in diameter and 36 in. long. Because of the enormous pressure required to pulverize the materials, the octagon faces of the centers would become badly pitted, especially in the center. After the pitting reached a certain stage there was not sufficient support for the chilled plates to prevent them from breaking.

When this stage was reached, it was necessary to resurface the octagon faces of the centers. At first, the work was done by filing and scraping to a surface plate, but it was an expensive and tedious job. Finally, I built the milling fixture *C*, shown mounted on one of the faces of the cast-steel center in the illustration. The fixture is virtually a large slide-rest, carrying a milling cutter mounted on a vertical spindle, the long slide being the crossrail of an obsolete planer. The drive was by worm gearing, the worm being connected to a 5-hp. motor by a flexible shaft of sufficient length. The base of the bracket for attaching the fixture to the center is at an angle of 45 deg., so that when the fixture was mounted on one of the octagon faces of the center, the cutter was in position for milling the adjoining face.

Two cuts were taken on each face, one on each side of the lengthwise key. After surfacing one face, the fixture was mounted on that face and operations were commenced on the next face adjoining, and so on until all the faces were trued.

While the under surfaces of the chilled plates also became pitted, the corrugated surfaces became so badly worn that new plates were necessary long before the centers required reconditioning. By the use of this fixture, the work was done in one-quarter of the time required for hand work.

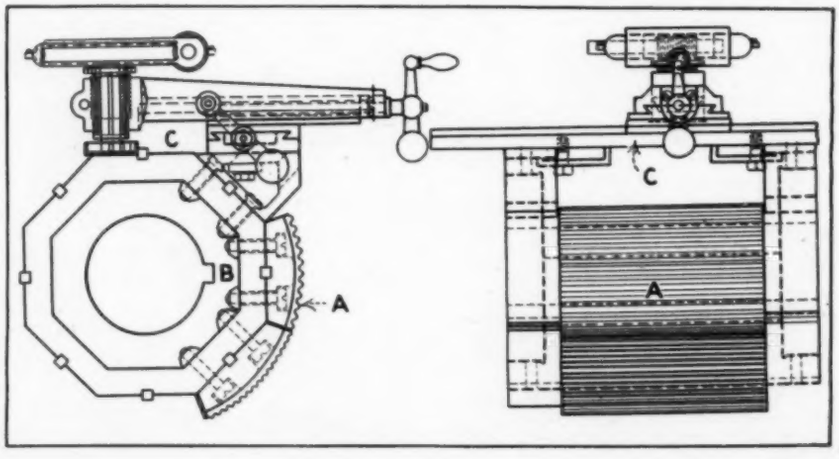
An Automatic Stop for the Lathe

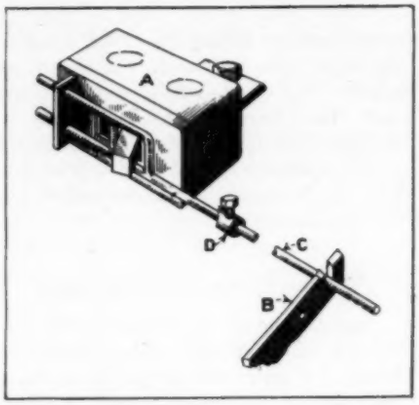
HERBERT P. HINCKLEY
President, Herbert Hinckley, Incorporated

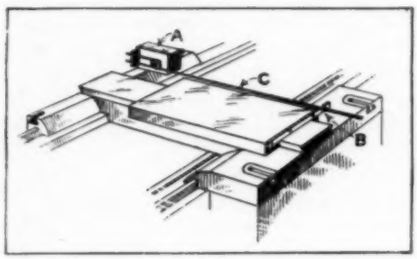
In the course of manufacturing, we had several parts that were made in small quantities every month or two. Some of these parts required facing and plunge cutting in the lathe, and while the operator was not kept busy all of the time, he had to be at his lathe to stop it when the cut was completed. In order to have the operator utilize some of his idle time, we added some simple attachments to the lathe that could be adjusted to stop it when the tool had reached the proper depth in plunge cutting, or when it had reached the center in facing.

Referring to Fig. 1, the double-pole, single-throw switch *A* was attached to one of the rear wings of the carriage and was wired between the switch controlling the lathe motor and the fuse box. The striker bar *B* was attached to the front of the toolblock. Lying in a notch in the striker bar is one end of the stop rod *C*. It has a loop at its rear end through which the switch lever projects. The rear end of the rod and the tail of the loop are guided by holes in a plate welded to the switch cover. The adjustable stop *D* completes the outfit.

When the stop rod is moved to the rear by the toolblock, it throws the switch lever, breaking the contact and







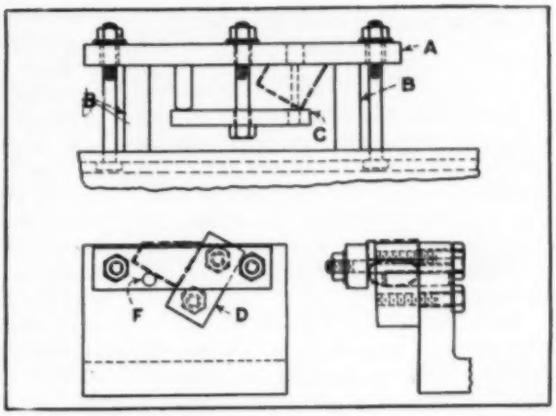
stopping the lathe motor. The front of the striker bar is beveled at the notch and the adjustable stop is beveled at its rear. After the lathe has been automatically stopped, if for any reason the operator wants to start it without either moving the toolblock or the adjustable stop, he lifts the stop rod out of its notch in the striker bar and pulls it toward him. When he lets the rod fall back into its notch, the adjustable stop will be in front of the striker bar. Then when he wishes to move the toolblock toward him, the bevels on the striker bar and the adjustable stop permit the adjustable stop to slide over the striker bar into operating position. In Fig. 2 is an assembly of the device, in which parts of the lathe have been omitted for the sake of clearness.

One of our drill presses was fitted with a similar device arranged to stop the feed at any predetermined point. An extra counterweight was added to raise the spindle when the feed was disengaged. After the operator started a cut on his lathe, he could set up a part in the drill press, or attend to any other matter, knowing that his lathe would stop when the cut was completed.

Set-Up for Boring Holes at an Angle—*Discussion*

HENRY W. BOEHLY

In an article under the title given above (*AM*—Vol. 76, page 767), Walter Wells describes a set-up by which he says he bored a hole through a cylindrical piece accurately at an angle. I believe it would be difficult to obtain accuracy with the set-up described by Mr. Wells, due to the slippery support of the work, which may be disturbed when tightening the clamps. Mr. Wells says that the work was automatically leveled in one direction by tightening the clamps. I can not quite agree with him, since it depends upon whether or not the under sides of the clamps are parallel with the machine table, which is not always the case. If the toes of the clamps should be rounded, the alignment would not be automatic in any direction.



The accompanying illustration shows two ways of setting up the work, either of which, I think, will eliminate some of the difficulties encountered in Mr. Wells' method. Above, the plate *A* is set parallel with the machine table by placing the parallels *B* under it. The workpiece, indicated by heavy dotted lines, is drawn up against the underside of the plate by the strap clamp *C*, thus holding it in accurate position in relation to the plate. The clamp *C* has a clearance hole for the drill or boring tool. A toolmakers' button is used to align the position of the hole with the spindle, a hole in the plate *A* being provided for its clearance.

Beneath, the same piece is shown clamped to an angle plate, resting against the block *D* and the stop pin *F*, the block *D* having been set to the correct angle by a sine bar. By mounting the angle plate on a vertical boring mill, the angular face of the work can be machined and the hole can be bored at the same setting with the assurance that it will be accurately at 90 deg. to the angular face of the work.

Moulded Compound Jigs

HARRY SHAW
Consulting Engineer, Heywood, England

Moulded compounds such as bakelite are usually thought of as forming part of a marketed product rather than as a material for the machines and fixtures for producing them.

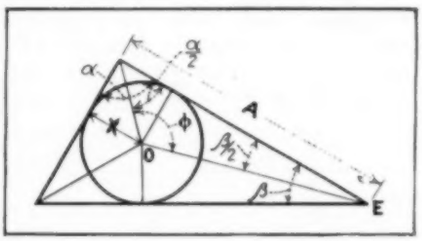
One small firm uses jigs made of a moulded compound for locating and holding small parts during a soldering operation, because of their lightness and because, unlike aluminum, they will not be attacked by the zinc chloride flux that is used.

Washing the jigs in warm water soon removes all traces of zinc chloride, whereas aluminum jigs must be scrubbed. The heat from soldering is not sufficient to have any effect on the jig.

Checking External Bevels *Discussion*

C. A. JOHNSON

While the article by John F. Thornton under the title given above (*AM*—Vol. 76, page 738) gives an accurate and simple method for checking external bevels, I wish to submit a single formula that can be applied to work having either rectangular or oblique sides.



The center *O* of the inscribed circle is located on the intersection of the lines bisecting any two angles, as β and α,

X = radius of the pin

$$\Phi = 180 \text{ deg.} - \left(\frac{\alpha}{2} + \frac{\beta}{2}\right)$$

By the law of sines:

$$\frac{OE}{A} = \frac{\sin \frac{\alpha}{2}}{\sin \Phi} \qquad OE = A \frac{\sin \frac{\alpha}{2}}{\sin \Phi}$$

$$X = OE \times \sin \frac{\beta}{2}$$

D = diameter of pin = $2X$

$$= 2A \times \sin \frac{\beta}{2} \times \frac{\sin \frac{\alpha}{2}}{\sin \Phi}$$

Trimming Tools for Gear Teeth

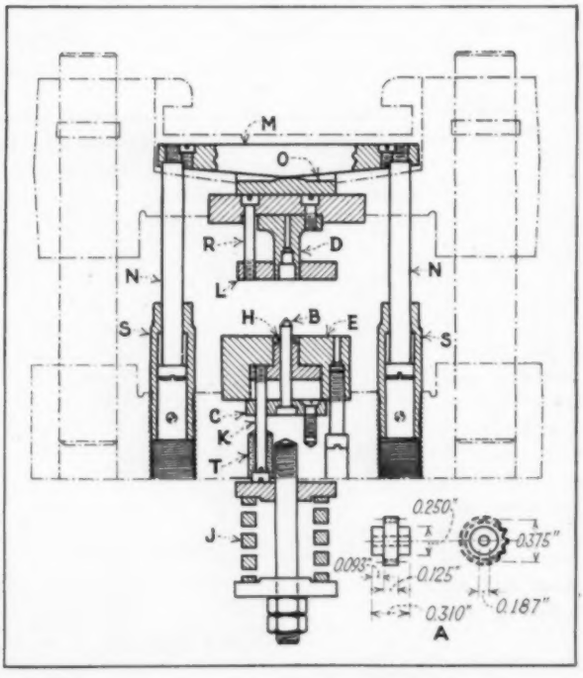
I. BERNARD BLACK

The press tools illustrated are for trimming the teeth of small, swaged gears, such as the one shown at *A*. No machine work is done between the swaging and the trimming operations, the holes being sized on a pin by the compression of the metal at the time the hubs are swaged.

Referring to the illustration, one of the gears is mounted on the pin *B*, which is held in place by the plate *C*. As the ram descends, the punch *D* pushes the gear into the die *E*, trimming the teeth. Due to the pressure of the punch, the shedder *H* recedes, being opposed by the heavy spring *J* to which connection is made through the long screws *K*. As the ram ascends, the finished gear is pushed out of the die by the action of spring *J* on the shedder, the gear being carried up by the punch. As the ram nears the top of its stroke, the gear is ejected from the punch by the shedder *L*, the action of which will be explained in describing the knockout. The interim between the commencement of the ram's ascent and the ejection of the gear gives time for blowing the shavings from the die by a blast of air.

In the knockout, the crossbar *M* floats in a recess in the punch-holder. The two plungers *N* are secured by lockscrews. The crossbar is in contact with the plate *O*, the screw *R* and the shedder *L*, which latter is flush with the lower end of the punch after the gear has been ejected. Plungers *N* reach down through the die-block into the two hollow studs *S*, which are hexagon in shape at the top to permit them to be adjusted by a wrench. After being adjusted, they are locked by setscrews.

In action, as the gear is trimmed, shedder *L* screws *R*, plate *O* and crossbar *M*, with the plungers *N*, recede. On the up stroke, the gear is carried up with the punch until the heads of the plungers *N* strike the shoulders in the hollow studs. When this takes place, the upward movement of crossbar *M*, shedder *L*, screw *R* and plate *O* are arrested, and, as the ram is still in upward motion, the gear is ejected from the punch. Since the press is inclined, the ejected gear drops into a receptacle at the rear.



SEEN AND HEARD

JOHN R. GODFREY

Punching Castings

We are all familiar with the punching of sheet metal and other rolled section, but the method is unusual for cast iron. However, at least one concern is punching holes in malleable castings instead of drilling them. Careful control of the malleabilizing cycle is essential for successful application, otherwise tool breakage and costs would be high.

Making Castings Stay Put

Cast iron, in common with other metals, has a way of refusing to stay put. And men are constantly asking for methods of treating castings so they will not change after machining. Unfortunately no one seems to know how to do the trick. Annealing may relieve internal stresses, but when we machine one side we relieve the skin tension there and the tension in the other surfaces promptly pulls it out of shape. By taking roughing cuts on the surfaces that pull the main surfaces out of shape, distortion can be greatly reduced. For this reason some surfaces are machined that would be left rough if it were not for spring of the casting. It used to be considered good practice to rough machine castings and put them in the open air to "age." This was later replaced by annealing.

Many question the value of aging or annealing and depend on rough machining all surfaces that might pull the others askew if the skin is left in place. In any case the individual casting should be studied, and machined or annealed, or both, to counteract the tendency of skin tension, or unequal mass, to pull it out of shape.

Where Brass Pays for Itself

The saving of a few cents by the builder of a marine motor not only wrecked a party but might easily have had disastrous consequences. A small but staunch cruiser was on a trip down the coast when the motor quit because the plates which covered the water jacket on the cylinder had rusted through. A high sea was running endangering all on a small craft without power. Fortunately they were picked up and towed into port. A few cents spent in making the plates of brass instead of steel would have saved all the trouble.

Small Cutters or Large?

Some production men seem to overlook the high cost of large milling cutters when planning a job. Two shops making a similar product afford examples of the two extremes. One shop designed fixtures that took a 12-inch cutter to get at the pads to be milled. The other shop rolled the piece into another position and used a 4-inch cutter. It isn't hard to figure the difference in cutter costs, which also affects the cost of the work done.

Gear Grinding Again

Gear tooth grinding is one of the operations that has had its ups and downs during the past twenty years. Demands for quiet gears in motor car transmissions led to the designing of several gear tooth grinding machines although one pioneering concern had been grinding gears before noise became an important factor in automobiles. Then we tried burnishing gears by running them with hardened gears. And lapping, of course, has always had its advocates. Helical gears and spiral bevels seemed to put tooth grinding on the shelf for a while. But now even the medium priced car makers are grinding helical teeth and also lapping them—which may not be so good for the gears. For those who ought to know point out that lapping destroys the tooth form and isn't so good after all. Some have found that at least part of the gear box noise can be eliminated by more care in designing the transmission case and in selecting the bearings.

• NEW BOOKS •

COMMERCIAL SURVEY OF THE PACIFIC NORTHWEST — *By Edwin Bates, special agent, U. S. Department of Commerce. 356 pages, 6x9 in., paper covers. Published by the Department as a unit of No. 51 of the Domestic Commerce Series. For sale by the Superintendent of Documents, Washington, D. C. Price, $1.00.*

Designed to furnish manufacturers and distributors with basic information on the character of the market of the Pacific Northwest and problems of distribution in wholesale and retail trade, this is one of a series of similar surveys to provide extensive and accurate information on the character of the American market. This survey covers the states of Oregon, Washington, the western part of Montana, and the northern portion of Idaho. It is replete with maps, tabular information and statitics on the economic background, sources of income, types of industries and transportation facilities. It includes an analysis by markets. Metallurgical industries are discussed on pages 35 and 57, the iron and steel and machinery industries on pages 58 and 59.

HOUSE DESIGN, CONSTRUCTION AND EQUIPMENT—*Edited by John M. Gries and James Ford. 313 pages, 6x9 in. Clothboard covers. Issued by the President's Conference on Home Building and Home Ownership. Price $1.15. (Checks should be made payable to John M. Gries, executive secretary, New Commerce Building, Washington, D. C.)*

Everyone should be interested in home building. Engineers and production men will, in addition, find special interest in the portions of this book recommending "manufactured" construction, labor saving tools, and improved construction methods. Of course, the book has all the ear marks of a committee publication and the wealth of information given could be put in greatly condensed form. But it is interesting anyhow.

ENDURANCE LIMIT AND DESIGN—*By Dr. A. Thum and Dipl.-Ing. W. Buchmann. 82 pages, 6x7 in. Paper cover. Published by VDI-Verlag, Berlin, N.W.7. Price 6.90 Marks.*

Confined entirely to the question of endurance limits, concentrated stresses, and the manner of making design calculations for these factors, this book is divided into four main parts. The first deals with the behavior of material under static loads and alternating loads, and discusses the phenomena of fatigue fracture. The second portion presents the conception of endurance strength, the method for determining the endurance limit, the relation between endurance limit and ultimate strength, testing methods, and testing machines. The third chapter is devoted to a discussion of concentrated stresses resulting from notch effect, and sets up methods for calculating the influence of the changes of section. In the final chapter are given rules for designing parts subject to alternating stresses and the method of applying the endurance-limit figures.

RAMBLING THROUGH SCIENCE. *By A. L. DeLeeuw, M.S.,M.E. 320 320 pages, 5½x8in. Illustrated by diagrams. Bound in cloth boards. Published by Whittlesey House, McGraw-Hill Book Co., Inc., New York and London. Price $2.50.*

Although Mr. DeLeeuw's book is intended for popular consumption it should be welcome to engineers and other industrial executives who are interested in the advances of science because of their ultimate, and often immediate effect on industry. The author, by education a physicist and by training and experience and engineer, brings to his task of interpreting science an unusual combination of theory, practice and a conversational literary style. He makes the fourth dimension seem obvious and he "rambles" widely from atoms to astral mechanics, and from light waves to the quantum theory. The reader cannot help acquiring a new and higher opinion of science and scientists as he "rambles" with Mr. DeLeeuw.

TECHNISCHE VOLLENDUNG UND HOCHSTE WIRTSCHAFTLICHKEIT IM FABRIKBETRIEB. *(Technical Accomplishments and Maximum Economies in Factory Operation) by G. Schlesinger, 106 pages with 80 illustrations, paper covers; published by Julius Springer, Berlin. Price RM 4.80.*

This valuable little booklet is divided into three parts, the first section being devoted to a survey of the latest machine tool equipment. The second section deals with the inter-relation of tools and construction materials, and the description of tools and machine tools.

The third section of the book discusses the three main phases of management: materials, wages, costs. Particular emphasis is placed on the unity of plan and procedure to obtain the necessary interdependence between work preparation, operation and controlled costs or discounts. Numerous charts and diagrams are used.

THE BUSINESS MAN AND HIS HEALTH—*By Jesse Feiring Williams, M.D. 171 pages, 5½x8 in. Clothboard covers. Published by Whittlesey House, the McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York, N. Y. Price $2.00.*

The early men whose skulls the modern scientists are digging up and classifying no doubt had problems of health, but not the same problems as face the "tired business man" of today whose physically inactive, mentally distraught, nervous existence makes him early a prey to disease. Necessary but natural steps in the preservation of a healthy body and sound mind are outlined by Dr. Williams in a pleasant informal fashion. He exposes several popular health measures as empty advertising, so far as benefit to the business man is concerned; urges rest, real vacations, freedom from all worry, addiction to hobbies, and outdoor games as distinguished from mere outdoor exercise. These, with periodic health examination by competent physicians, will keep a man fit and free from concern about the status of his arteries, according to the author.

WORLD SOCIAL ECONOMIC PLANNING—*M. L. Fledderus, Editor. Two volumes 6x9¼ in. totalling 935 pages. Published by the International Relations Institute, The Hague, Holland, and Room 600, 130 East 22nd St., New York. Price $2.50 for the two volumes.*

While this is really one book, it was divided into volumes for convenience in handling. Both together constitute a second book resulting from the 1931 World Social Economic Planning Conference and present the formal papers on a subject that is attracting world-wide attention. Discussion of the papers as well as an analysis of them and of the material in the first volume on International Unemployment is included. This was reviewed in *American Machinist*, Vol. 76, p. 950. For the convenience of those who cannot read the entire contents, either through lack of time or knowledge of French and German, a splendid 64-page analysis of the proceedings has been prepared by Miss Mary Van Kleeck. This points out the high spots and helps the reader select the phases of the subject in which he is most interested. The analysis can be studied to advantage before passing to the papers themselves.

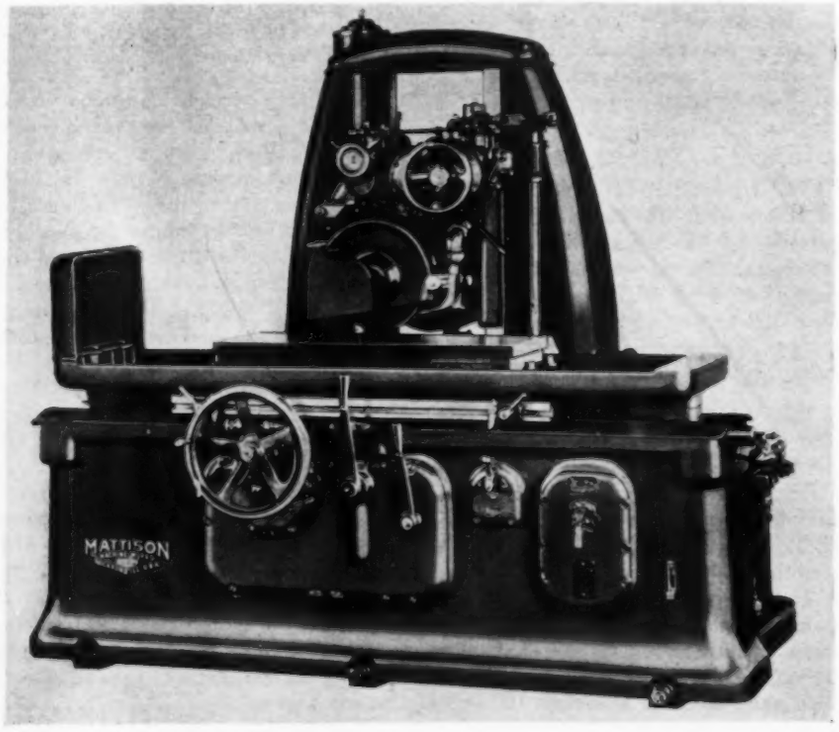
SHOP EQUIPMENT NEWS

Mattison 12-14 In. Hydraulic Surface Grinder

For toolroom work, as well as for production grinding, the Mattison Machine Works, Rockford, Ill., is offering a 12-14 in. surface grinder. A characteristic of this grinder is the built-in motor construction with the rotor mounted directly on the wheel spindle and balanced as a unit. It is said that this construction eliminates vibration on the wheel spindle and delivers full power. The wheel spindle is mounted in a heavy housing which is carried on the horizontal ways of the wheel slide assembly. This assembly is in turn supported between two massive columns having large taper-gibbed ways. With this design stronger and more secure working parts are claimed.

The longitudinal table travel is hydraulically operated by two cylinders which provide uniform speed in either direction. Stroke is adjustable to cover any portion of the table up to its maximum. Table speed ranges from 30 to 90 ft. per min. Transverse feed of the wheel is also hydraulically operated. The wheel automatically advances across the work 1½ in. at each reversal of the table. Both quick-acting and low-geared cross feeds, with automatic reversal, can be operated by handwheel, either for grinding or wheel truing.

Controls are centralized at the front of the machine within convenient reach of the operator. A hand or power hoist can be used for raising the wheel. Downward movement of the wheel is controlled by a separate pushbutton, which is so arranged that the travel continues only while the operator keeps the button depressed. Final adjustment is made by handwheel and stop with micrometer graduations of 0.0001 in. Reversing of the wheel-slide traverse is accomplished automatically, both on hand and hydraulic feeds, by two dogs on a circular disk, easily adjustable and located directly in front of the operator. This mechanism also serves as a quick means for locating the wheel in the center of the work. With the automatic cross-feed feature, it is possible, on many types of grinding, for one man to operate two machines at the same time.

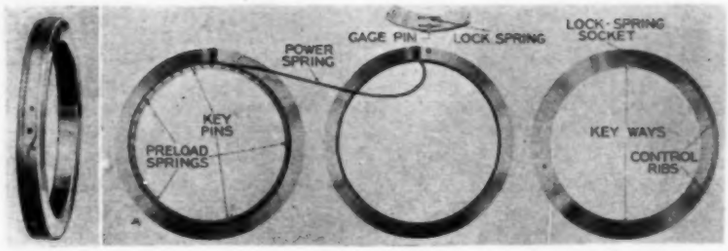


Specifications: Table dimensions—working surface, 12 or 14 in. wide by 3, 4 and 5 ft. long; wheel head adjustments, vertical, to allow 16½ in. between table surface with 14-in. wheel; table feed, hydraulic, with 4 speeds, 30, 45, 60 and 90 ft. per minute, using multi-speed motor; wheel cross feed, both hydraulic and hand, total traverse, 10 in. to cover 12-in. surface, or 12 in. to cover 14-in. surface with 3-in. wheel face; motors: wheel spindle, 15-hp. a.c., 220, 440, or 550 volts, 60 cycles; hydraulic, coolant and lubricating pumps driven by 5-hp. ball-bearing motor; wheel head raising and lowering motor, ½ hp.

Wyromatick Compensator

Federal-Mogul Corp., Detroit, Mich., announces the completion of development work on the Wyomatick compensator (*AM.*-Vol. 73, p. 1022), and purchase of all manufacturing rights. The compensator, as originally developed, was intended purely for the purpose of constant automatic maintenance of bearing adjustments. As now produced, it is provided with controlled preload that insures the maintenance of any clearance necessary to allow for expansion and contraction. It is claimed that any specified bearing adjustment can be held within 0.00025 in., and the bearing adjustment may be as snug or as free as the designer specifies. Since wear once started proceeds with marked acceleration, automatic adjustment has been shown on test to add greatly to bearing life, to make for quieter operation, and to insure shaft alignment.

As shown in the accompanying illustration, the compensator has the general appearance, occupies about the same space, and is almost as simple to install as an ordinary spacing washer. Springs inserted in the master cam supply the power to take care of the preload feature and are varied in number to give the exact preload specified. The master and gage cams are a pair of mating helical-cam-faced members, which, when assembled in their power position, will in-



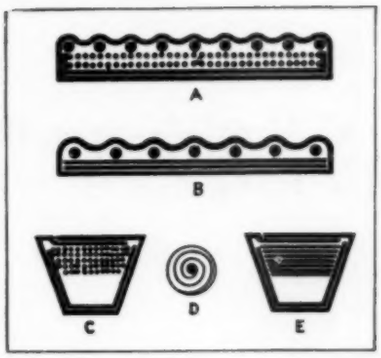
crease their joint cross-sectional dimension when rotated in opposite directions. When the compensator is assembled, it is wound and held in the wound position by the lock spring which engages in the lock spring socket. When it is drawn up in a bearing assembly, the pressure releases the lock spring. Then the power spring urges rotation of the gage cam; but this rotational action is stopped by the gage pin engaging one of the ribs of the control washer.

Assuming the compensator is set to take up wear in increments of 0.001 in., the preload springs are constantly urging separation between the master cam and control washer; likewise the lock spring is continually urging separation between the gage cam and control washer. Then, when 0.001 in. of wear has occurred beyond that initially allowed as minimum for expansion and contraction, the gage pin passes one rib; that much rotation between the master and gage cams increases their joint cross-section exactly 0.001 in. so they can go no farther until another 0.001 in. wear has occurred. It is claimed that Wyromatick compensators are practical for use with almost every type of bearing: roller, ball or for end thrust on plain sleeve type. They are available in a full range of standard and special sizes.

Gilmer Belts

In the accompanying illustration are shown cross-sections of five new belts recently placed on the market by L. H. Gilmer Co., Tacony, Philadelphia, Pa. The "Panama Kable Kord" endless belt at *A* is said to combine two belts in one. The lower section, comprising layers of parallel pulling cords, does the actual transmitting of power. Upon this section are superimposed heavy Kable-Kords which have the function of squeezing the lower pulling cords tight to the pulley face or, in other words, acting as the "contactor" belt. The jacket of the belt is double on the face which engages the pulley and single at the top. It is furnished in a wide range of sizes and weights.

The Kable-Kord non-endless *B* is constructed on a principle similar to that of the endless belt; it comes in rolls and, instead of using cords for the pulling

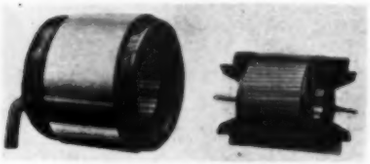


medium, utilizes heavy specially woven belting duck. The top cover and the bottom cover or jacket each count as a ply. The inside plies are laid parallel with the bottom, and the sides are brought around into the top cover or jacket and over the Kable-Kords. These cords incidentally are spaced three to the inch. Alligator or clipper lacing may be used.

An improved V-type belt (patent pending) has been designed with a view to eliminating internal heating. As shown at *C*, numerous strands of fine cords are used in the upper half of the belt rather than a few strands of large cord. The fine cords are supported by a highly resistant, yet resilient rubber, which holds the cords in their position when they are pulling a load. A heavy specially woven jacket encases the belt, as shown. It is claimed that under a maximum load condition this V-belt will stretch less than 1 per cent. The V-type non-endless belt, shown at *E*, is constructed of plies of special fabric rather than of cords as in the former. The same bottom rubber is used, and the same jacket material acts as the outside surface. A piece of this belting is cut to the desired length and hooked together with a hook very much resembling the old style hooks used in round belting.

At *D* is shown the construction of Gilmer round belting which is rolled out of a special fabric, rubber impregnated. Since it is then molded under extremely heavy pressure in accurately cut molds, a cross-section taken at any point is as nearly a perfect circle as possible.

"Speedage" belts, not illustrated, are produced especially for high speed on machine tools or woodworking tools. These fabric belts are woven endless and can be made into weights and thicknesses to apply to practically any design. Belts of this construction are said to be in operation at speeds of 6,000 to 12,000 ft. per min.



Allis Rapid-Reversing Motors

Rapid-reversing, squirrel-cage motors, capable of 60 reversals per minute continuously without overheating, have been placed on the market by The Louis Allis Co., Milwaukee, Wis. It is said that such a high rate of reversal has been made practical through light-weight rotor construction, efficient ventilation, high-torque characteristics and shock-resisting cast-iron frames. These motors are suitable for machines that utilize fast reciprocating or reversing motions or require frequent starting and stopping. The motors can be furnished in the standard open ball-bearing type or rolled-shell shaftless type, as shown, and in vertical, single-speed, mblti-speed, inclosed fan-cooled, and other squirrel-cage types. No auxiliary ventilation is needed in sizes up to 5 hp.

"Cassvell" Vellum Tracing Paper

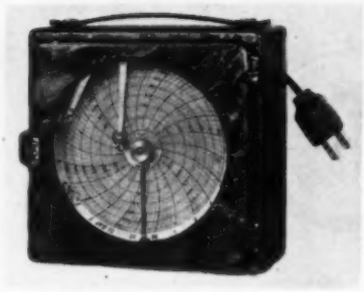
The National Consumers Paper Corp., Technical Papers Division, 227 Sixth Ave., New York, N. Y., has announced a "Cassvell" vellum tracing paper. The claims made for this tracing paper are: Dry surface—will not transfer oil; white-odorless; will not become brittle; will not become yellow; tracing cloth pounce unnecessary; permanent transparency; and good erasing qualities due to the dry surface. Cassvell vellum No. 102 is supplied in 20-yd. rolls, 36 in. wide, or in 20-yd. rolls, 42 in. wide.

Tagliabue Miniature Recording Thermometers

Miniature recording thermometers have recently been placed on the market by the C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y. The miniature-size recorders are developed in two forms—a single-pen recording

thermometer for charting temperature only, and a temperature and time-operation recorder which writes a continuous record of temperature as well as the running and idling time periods of the motor.

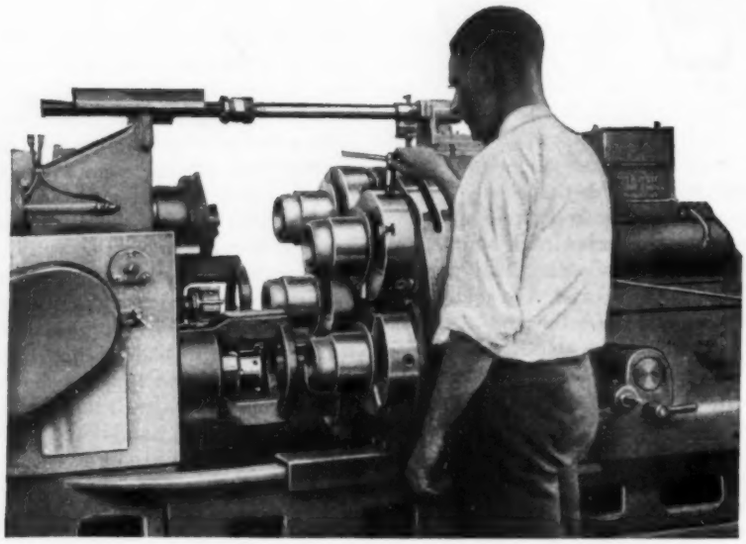
The square case and door of these instruments are aluminum castings. A special non-breakable transparent front is fastened in the door by a four-screw retaining plate. Dimensions are: 5¾ in. high; 5¾ in. wide; and 4¼ in. deep.



Morrow Oil Filter

A specially impregnated felt is the filtering medium used in an oil filter recently announced by the H. B. Morrow Co., Mishawaka, Ind. As shown in the illustration, the oil in the cup must pass in an upward direction to the inside of the cone, thence out through the exit hole in the cup's central tube to the bearing. By this construction the filter membrane works in a semi-inverted position, and is so protected from all direct pollution by the coarser and heavier settlings from the oil, which are automatically separated out by gravity and deposited at points away from the filter surface. Since ample filtering surface is provided, it does not retard the flow or delivery of the cup's flow capacity even with the needle valve entirely removed. Sizes are available for practically all standard types of oil cups.

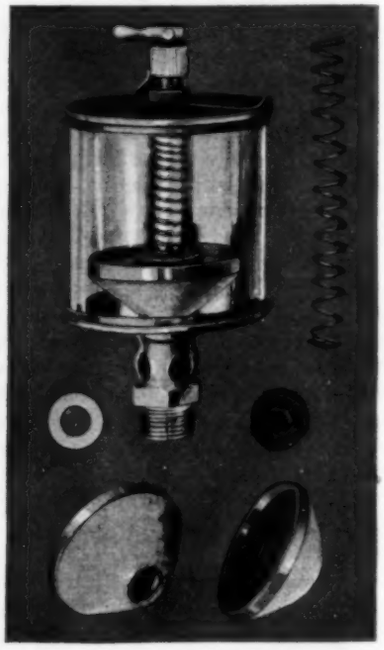
Goss & DeLeeuw "Duplex" Multiple-Spindle Chucking Machines



All the tools and all the chucks can revolve simultaneously on the line of "Duplex" multiple-spindle chucking machines developed by the Goss & DeLeeuw Machine Co., New Britain, Conn. Various other combinations can be had in the same machine, such as: all the tools revolving and the chucks remaining stationary; the chucks revolving and all the tools remaining stationary; or the chucks revolving and any number of tools revolving, the others remaining stationary. Two standard cross-slides are provided.

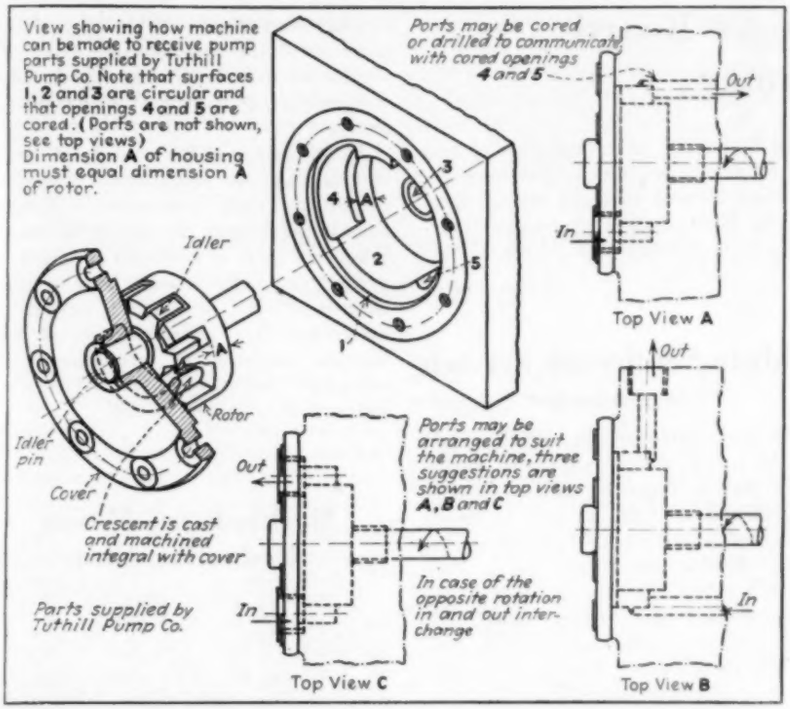
The Duplex machines supplement the company's four-spindle tool-revolving machines known as the 6x6¾, 8½x8, and 11x10 in., and are basically the same in design. However, the Duplex machines carry a different faceplate for the revolving chucks and have two cross-slides added. The tool spindles and their drive remain the same as does also the heavy turret with its integral cam feed.

Chuck spindles are mounted on large anti-friction bearings, either ball or taper roller, in the deep faceplate and obtain their drive from a separate motor. Each chuck, as it indexes into the loading position, is thrown out of engagement automatically with its drive, and stops to enable the operator to unload the finished piece and load another piece. It automatically starts to revolve again as it indexes out of the loading position. Positive tooth clutches are employed at this point, and they are operated by a mechanism that is claimed to require no adjustment for slippage or wear. Change gears provide a wide range of chuck speeds. The large cross-slides located in the first and third tooling positions are supported on the turret ways of the machine and are operated by means of the movement of the turret slide. The smallest Duplex machine, 6x6¾ in., has a maximum feed stroke of 6¾ in., and will swing a piece 6 in. in diameter. The largest machine is the 11x10-in. size. If they are used solely as tool-revolving machines, larger pieces can be handled.



Tuthill Standard Pump Parts

To permit designers of machinery to blend the design of the lubricating or coolant pump into the machine, the Tuthill Pump Co., 131 W. 63rd St., Chicago, Ill., is now offering a standard cover, idler pin, idler and rotor for assembly into the design of the housing most suitable for the purpose. Machining of the housing or packing box arrangement is simple and can be performed on an engine lathe at a single setting as all bores are circular and concentric. Complete dimensions are furnished by the manufacturer to insure


View showing how machine can be made to receive pump parts supplied by Tuthill Pump Co. Note that surfaces 1, 2 and 3 are circular and that openings 4 and 5 are cored. (Ports are not shown, see top views) Dimension A of housing must equal dimension A of rotor.
Idler
Rotor
Idler pin
Cover
Crescent is cast and machined integral with cover
Parts supplied by Tuthill Pump Co.
Ports may be cored or drilled to communicate with cored openings 4 and 5
Ports may be arranged to suit the machine, three suggestions are shown in top views A, B and C
In case of the opposite rotation in and out interchange
Out
In
Top View A
Top View B
Top View C

proper machining. It is said that under this system the designing engineer is permitted almost any combination of port arrangements with assurance of a compact pumping unit.

The accompanying diagram shows an isometric view of the parts furnished, with a similar view indicating the machining necessary to receive these parts. The only requirement is that the ports must communicate with the cored recesses indicated by Nos. 4 and 5, and must be large enough to keep the velocity of the pumpage down to a figure consistent with its viscosity. A few porting arrangements are shown in the three top views: *A*, *B* and *C*. These port passages may be drilled or cored in any number of arrangements. The intake and discharge ports, represented respectively by "in" and "out" on the diagram, will interchange when the direction of the shaft rotation is reversed. Counter-clockwise rotation is shown on these views. In many cases, slight leakage at the shaft end of the pump will not affect the operation of the machine. No stuffing box will be required in such instances.

Reed-Prentice Universal Ring Drilling Fixture

For drilling holes on the outside diameter of adjusting collars and work of a similar nature, the Reed-Prentice Corp., Worcester, Mass., is introducing a universal ring drilling fixture. The capacity is as follows: 1¼ in. diameter minimum,

6 in. maximum. Holes can be drilled to the center of the 6 in. width of maximum size rings. Holes from ⅛ to ⅝ in. diameter can be drilled. The illustration shows the fixture ready for use on a drill press.

Gisholt Special Boring Machine for Brake Drums

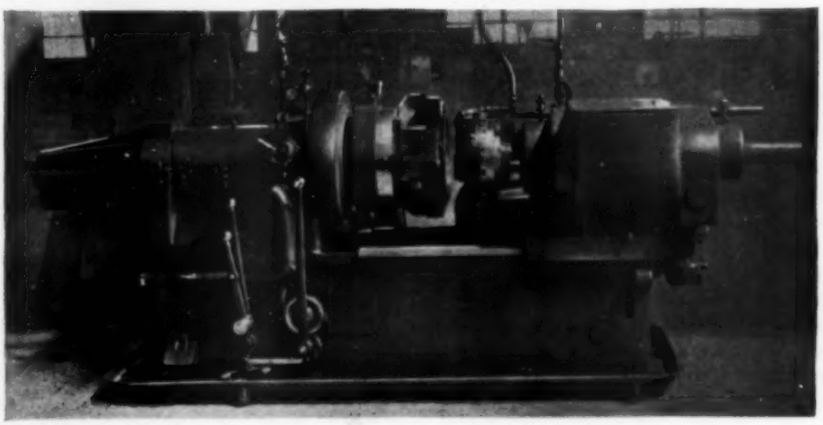
Unusual features are embodied in the special machine built by the Gisholt Machine Co., Madison, Wis., for roughing out a front wheel hub and brake drum consisting of a single special malleable-iron casting. Replacing the standard Simplimatic traversing platen table is a fixed tailstock housing. This housing carries a boring spindle actuated by a large diameter continuous cylindrical cam and the necessary gearing to complete the feed mechanism. Such equipment is of interest because of the returning vogue for iron brake drums.

In place of the customary air chucking equipment is a wrenchless chuck operated by an air cylinder mounted on the rear of the machine. This leaves the bore of the work spindle clear for the addition of a back-boring attachment.

When the machine is started, all tools traverse rapidly to their starting positions. The boring head carries twelve tools for roughing out the 13 x 3⅞-in. braking surface and six tools for the inside tapered roller bearing seat in the hub. The back-boring attachment carries a six-cutter boring head for the outside tapered roller bearing. The rear slide, mounted at a 45-deg. angle with the axis of the work, carries tools for chamfering the bore, facing and for turning the outside diameter. There are a total of 27 cutting tools and blades feeding in four different directions.

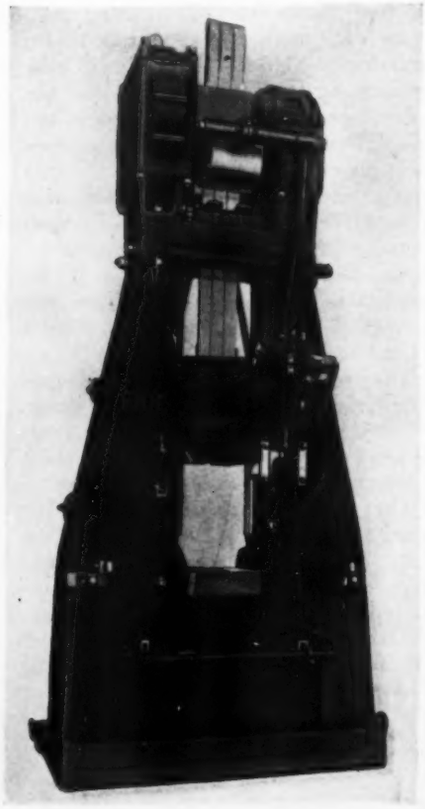
The use of cemented carbide tools permits higher cutting speeds, and multiple cutter boring heads permit heavier feeds to allow the machine to turn out these drums in 1¼ min. each, floor-to-floor.

The second operation of facing the wheel seat and finish boring the bearing seats, and the third operation of finish single-point boring the braking surface concentric with the tapered roller bearing cups are performed in 1¼ min. and 2½ min. respectively in Simplimatics of a more standard nature.



Erie Variable-Stroke Board Drop Hammer

A light or heavy blow, a short or long stroke, can be chosen at will by the operator for the variable stroke board drop hammer developed by the Erie Foundry Co., Erie, Pa. In this design the length of stroke is not adjusted in the conventional manner, but is subject to quick change by the operator. The hammer is treadled in the usual manner with one foot, and the length of the stroke is governed by a slight rocking of the foot on the treadle, which is in effect merely a shifting of the weight from toe to heel or vice versa. The illustration shows the variable stroke construction applied to a Type M motor-driven board drop hammer. The construction is simple and costs only slightly



more than the ordinary design and can be applied to existing hammers.

The chart of a recording-type wattmeter connected in the circuit of a 20-hp. motor operating a 2,500-lb. Type M hammer brought to light several features of the variable-stroke design. A considerable saving of power was evidenced when striking short blows, and also showed that greater speed was obtained, and consequently greater production. For example, the chart showed that the hammer was working anywhere from 96 to 54 blows per min., using short and long strokes respectively. Furthermore, the chart showed that the change from long to short strokes was made practically instantaneously.

Baldwin-Southwark Scratch Extensometer

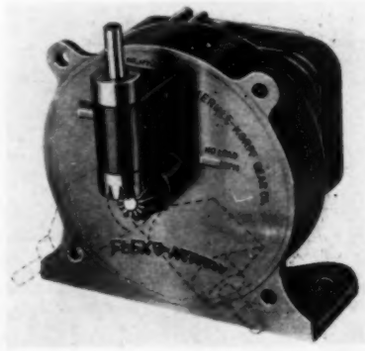
A scratch extensometer, which weighs less than an ounce, which is hardly larger than a teaspoon, and which may be attached to light as well as heavy structures, is being placed on the market by the Baldwin-Southwark Corp., Philadelphia, Pa. The device records the tension-compression strain and, also when tension-compression strain is present, will record shear strain. It is necessary to make a special adaptation when pure shear strain alone is to be recorded.

In this device a diamond is mounted so as to be under a small, but adjustable, load. The diamond bears on a target of specially heat-treated steel. Strain in the member under test causes the diamond to scratch a record on the target. Simultaneously the target is under a resultant force—manually variable—which causes it to move at right angles both to the axis of the instrument and to the axis of the diamond. Hence, one coordinate of the record indicates strain, while the other has no meaning but affords a measure of the variability of the resultant transverse force and the amount and rate of strain variation. There is no motion of the target when there is no change of strain. Strains are evaluated from the record by filar microscopes which may be of the moving eyepiece or of the moving-table type. Or the record may be photographed microscopically and the print measured directly.

An advantage of the scratch extensometer is that no multiplying system is needed on each instrument. Targets may be filed away for future reference. Wherever there is variation in strain, or where there are occasional large or small variations with intervening periods of inactivity, this instrument is of use. Various methods of attachment are available. Bulletin No. 40 describes the instrument in greater detail.

Merkle-Korff Power Reduction Unit

A compact power-reduction unit has been placed on the market by the Merkle-Korff Gear Co., 213 N. Morgan St., Chicago, Ill. This unit can be supplied in any speed from 3,000 r.p.m. down and for either clockwise or counter-clockwise rotation. It is constructed so as to be attached easily to any device or mechanism. Both horizontal and right-angle drives can be supplied, and



the right-angle drive can be had in any position within the 360 deg. circle. An induction (shaded-pole motor) or synchronous motor is used with the reduction unit. Over-all dimensions are as follows: Horizontal drive, height, 3⅛ in.; width, 3⅜ in.; depth, 2⅞ in.; Right-angle drive, height, 3⅛ in.; width, 3⅜ in.; depth, 3⅞ in. The unit is said to be low-priced.

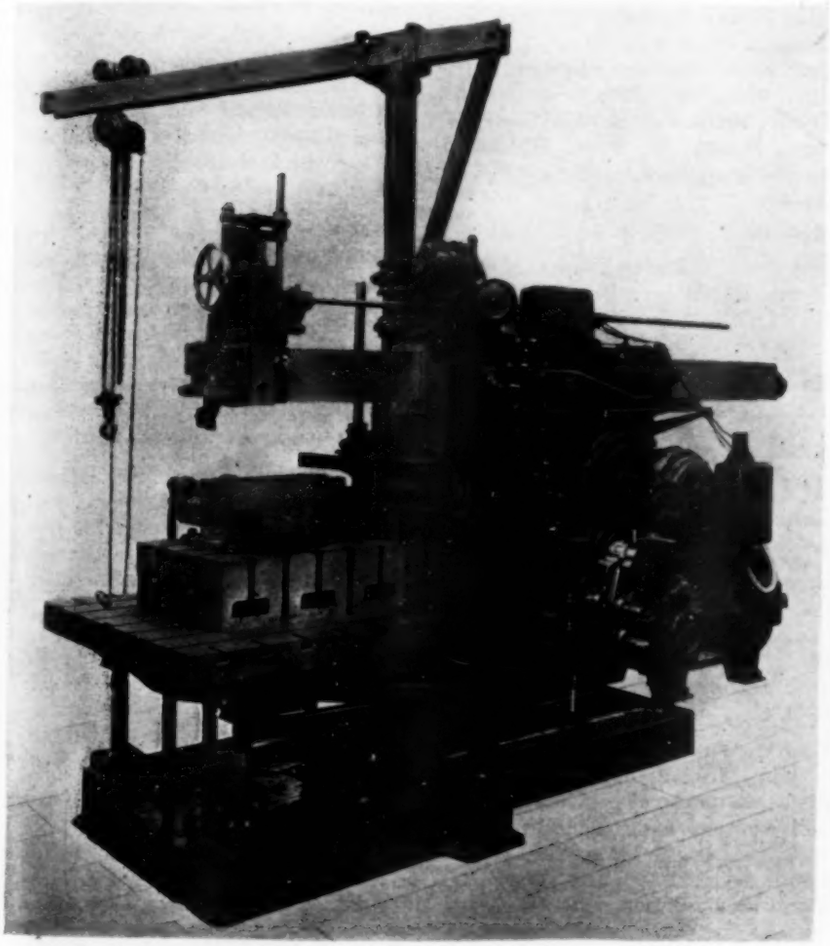
Morton 60-In. Stroke High-Duty Draw-Cut Shaper

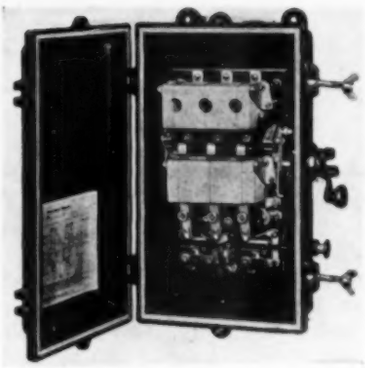
The Morton Mfg. Co., Broadway & Hoyt St., Muskegon Heights, Mich., has announced a 60-in., high-duty, draw-cut shaper for industrial and railroad shops, of which a feature is the special head that has motor-driven rapid traverse and 14 in. of vertical feed. The shaper has 60 in. of stroke, 60 in. of horizontal or side feed, and 27 in. of vertical feed. Distance between the ram and the subtable is 38 in. It is also furnished with a special push and pull out clapper box with a tool slot on either side.

The shaper is of the four-screw type, which makes possible the handling of heavy and bulky castings. It has rapid power traverse, both horizontal and vertical, and also automatic feeds which can be changed while the machine is in motion. It requires 15 hp.

The shaper is used in handling locomotive repairs of the following classes: front and back deck castings, frame braces, large frame binders, trailer guides, trailer boxes, cross-cut on main frames, unit drawbar attachment, feedwater heater and air-pump brackets, radial buffer castings, squaring up jaws on commonwealth engine trucks, back valve heads with valve crosshead guides and furnace bearer castings.

The machine will also accommodate various attachments for railroad work, such as shell planing, shoe and wedge, locomotive crosshead and rod brass attachments.





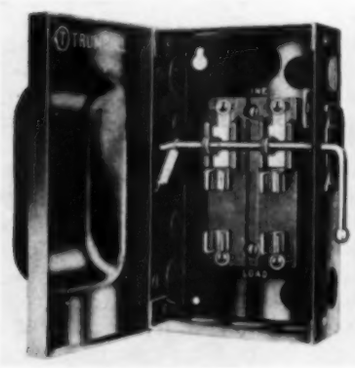
"Square D" A.C. Combination Starters

A.c. combination starters of water and dust-tight construction in the cast-iron type have been added to the line manufactured by the Industrial Controller Division, Square D. Co., Milwaukee, Wis. The apparatus is intended for installation on machinery in damp or dusty locations and corrosive atmospheres. However, the equipment is not explosion proof.

The unit consists of an across-the-line starter, motor control switch and test jack. Thermal overload protection and low-voltage protection are provided. Starters are built in two sizes known as Class 8532S and 8536S, and can be furnished fusible or non-fusible.

Trumbull High-Speed Switch

The Trumbull Electric Mfg. Co., Plainville, Conn., has added to its line of manually operated switches a 2-hp., Type D, inclosed switch for general use and motor starting service. This switch, No. 24921, is intended for 230 volts a.c. or 250 volts d.c. and is of 30 amp. capacity, fusible, and has 2 poles and 2 blades. The blades are of the double-butt wiping-contact type and operate under pressure.



• PATENTS •

AUGUST 16, 1932

Metal-Working Machinery

Internal Grinder Control. Clifford T. Raule, Brookline, Pa. Patent 1,871,468.

Grinding and Polishing Machine. Gustave A. Carlson, Detroit, Mich. Patent 1,871,494.

Grinding Machinery. George A. Volz, Cincinnati, Ohio, assigned to Cincinnati Grinders Incorporated. Patent 1,871,866.

Grinding Machine. Arthur Angus Nichols and William Hart Nichols, Waltham, Mass. Patent 1,872,041.

Feeding Mechanism for Grinding Machines. George H. Smith, Worcester, Mass., assigned to Norton Co. Patent 1,872,191.

Drilling Machine. Joseph F. Buhr, Detroit, Mich. Patent 1,872,400.

Grinding Machinery. John E. Caster, Cincinnati, Ohio, assigned to Cincinnati Grinders Incorporated. Patent 1,872,405.

Milling Machine. Hans Ernst and Mario E. Martellotti, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,872,431.

Automatic Punch Press. Bror J. Lindgren, Buffalo, N. Y., assigned to Niagara Machine & Tool Works. Patent 1,872,474.

Grinding Machine or the Like. Merton H. Arms, Springfield, Vt., assigned to Bryant Chucking Grinder Co. Patent 1,872,552.

Milling Machine. Hans Ernst and Lester F. Nenninger, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,872,627.

Tools and Attachments

Truing Device for the Wheels of Grinding Machines. Sol Einstein and Lester F. Nenninger, Cincinnati, Ohio, assigned to Cincinnati Grinders Incorporated. Patent 1,871,504.

Self-Opening Die Head. Albert F. Breitenstein, New Haven, Conn., assigned to The Geometric Tool Co. Patent 1,872,059.

Adjustable Die Head. Albert F. Breitenstein, New Haven, Conn., assigned to The Geometric Tool Co. Patent 1,872,060.

AUGUST 23, 1932

Metal-Working Machinery

Work Sizing. William J. Bryant, Springfield, Vt., assigned to Bryant Chucking Grinder Co. Patent 1,872,667.

Honing Machine. Albert M. Johnson, Rockford, Ill., assigned to Barnes Drill Co. Patent 1,872,746.

Control Mechanism for Grinding Machines. Peter Plantinga, Greenfield, Mass., assigned to Greenfield Tap & Die Corp. Patent, 1,873,151.

Automatic Lathe. Leo. C. Shippy and Alva W. Phelps, Anderson, Ind., assigned to Delco-Remy Corp. Patent 1,873,157.

Machine Tool. Worthy J. F. Forward and Roland Russell Roberts, Rochester, N. Y., assigned to Consolidated Machine Tool Corp. of America. Patent 1,873,375.

Machine Tool. Worthy J. F. Forward, Rochester, N. Y., assigned to Consolidated Machine Tool Corp. of America. Patent 1,873,376.

Grinding Machine. Fred. M. Kern, Detroit, Mich., assigned to Cincinnati Grinders Incorporated. Patent 1,873,423.

Machine Lathe. Alfred Trosch, Rochester, N. Y., assigned to Consolidated Machine Tool Corp. of America. Patent 1,873,678.

Grinding Machine. Warren F. Fraser, Westboro, Mass. Patent 1,873,751.

Grinding Machine. Warren F. Fraser, Westboro, Mass. Patent 1,873,752.

Tools and Attachments

Hobbing Cutter and Method of Making Same. Oliver G. Simmons, Lakewood, Ohio. Patent 1,873,158.

Cam Grinding Fixture. Leo C. Shippy and John Q. Holmes, Anderson, Ind., assigned to Delco-Remy Corp. Patent 1,873,224.

Cylinder Hone. Clarence T. Rottler, Seattle, Wash. Patent 1,873,330.

Hopper Feed Apparatus. Lee A. Frayer, Kent, Ohio, assigned to Roy H. Smith. Patent 1,873,377.

Truing Mechanism for Grinding Machines. Stanley W. Bath, Worcester, Mass., assigned to John Bath. Patent 1,873,530.

Processes

System of Lapping Taper Rollers. William E. Hoke, Baltimore, Md. Patent 1,873,647.

• TRADE PUBLICATIONS •

CAST IRONS. The U. S. Department of Commerce, Bureau of Standards, has issued Research Paper No. 440 entitled "Volume Changes of Cast Irons During Casting." Copies are for sale by the Superintendent of Documents, Washington, D. C.

CRANES, OVERHEAD. Catalog No. 214, issued by Whiting Corp., Harvey, Ill., contains 68 pages of pictures and descriptive matter on a complete line of electric and hand-power traveling cranes. Many installation views are shown, together with details of construction and optional features.

FOREMEN'S SAFETY CONFERENCES. Issued by the Policyholders Service Bureau, Metropolitan Life Insurance Co., 1 Madison Ave., New York, N. Y., is a pamphlet "Foremen's Safety Conference," which presents a method being used extensively to develop safety interest among foremen and others in supervisory positions.

HARD RUBBER. Furnished on request by the B. F. Goodrich Rubber Co., Akron, Ohio, is a new booklet on hard rubber in sheet, rod and tubing form. Among subjects discussed in the book are: Properties of hard rubber goods; machining qualities; finish and tolerances; possible variations and suggestions for machining.

HOISTS. Philadelphia Gear Works, Erie Ave. at G St., Philadelphia, Pa., has published a folder "The Philadelphia Electric Hoist" announcing and describing its new electric hoist and giving clearance dimensions and standard capacities and ratings.

LATHE CENTERS. Published recently by The Ready Tool Co., Bridgeport, Conn., is a folder on its line of precision ball bearing centers designed for lathes and cylindrical grinders. Illustrated are several special applications.

PUMPS. The Baldwin-Southwark Corp. Philadelphia, Pa., is distributing Bulletin No. 36, a 12-page publication covering its line of high-pressure hydraulic pumps, both horizontal and vertical. A description of the construction of these pumps, together with tables of dimensions and of capacities, is included.

STAINLESS STEEL TUBING. The Carpenter Steel Co., Welded Alloy Tube Division, 100 Broadway, New York, N. Y., has recently published a folder on stainless welded tubing in round, square and rectangular shapes as well as in special shapes. The folder gives general information, physical properties and working instructions.

TENSOMETERS. Bulletin No. 37, issued by the Baldwin-Southwark Corp., Philadelphia, Pa., contains 12 pages on lever-type strain gages known as Huggenberger tensometers. A short technical discussion of the fundamental principles of these instruments is followed by detailed data and suggestions concerning applications. The tensometer is a multiplying lever device for measuring the strain in a specimen under load and thereby obtaining a measure of the stress in the specimen.

WELDING SETS. The Lincoln Electric Co., Cleveland, Ohio, is distributing "The New Lincoln 'Shield-Arc' Welder," a publication describing a new welding set in extensive detail.